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CHINESE IRON FOUNDRIES

By F. A. Foster

Chinese porcelains and Chinese rugs are familiar objects in this country but products of Chinese foundries are scarce. Their methods are undoubtedly crude when compared with our own, but some of their results are quite remarkable for thinness and smooth finish. The foundrymen are supplying the demands of their country for castings, and when the quality of the demand changes with the introduction of our machinery, they will rise to the occasion.

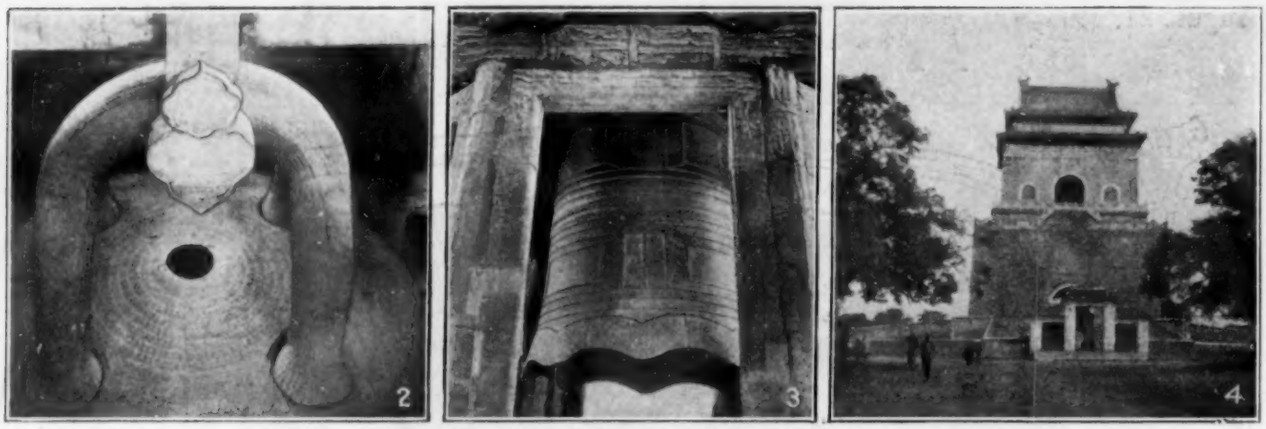
IT IS a well-known axiom that the modern nations which have no well-developed iron supply are weak. This is borne out by the case of China which has abundant but undeveloped iron deposits, and affords a curious but corroborating example and an interesting study for the economist and historian.

That China started out early and well in her use of metals is amply attested by numerous well preserved records and metal products, both large and small, from a time so remote that it makes the industrial history of our European ancestors look very young. When the people in most parts of Europe were going about dressed in the skins of wild animals and using pieces of stone tied to sticks for tools and weapons, the Chinese were a highly developed and skillful nation. Among the great feats which bear evidence of their industrial and engineering superiority are the oft-cited Great Wall, and their great canal systems. The invention of gunpowder, the art of printing with movable type and the magnetic needle were all Chinese inventions and played a large part in shaping the world's history. Their marvelous bronze castings and their paintings attest to their artistic ability.

FIG. 1. HUGE BELL IN A TEMPLE NEAR PEKING

There is that in their nature or philosophy which has preserved them where all other nations who were contemporaneous with their youth have fallen. The political, social and philosophical elements which are necessary for the making of a great nation remain, and present indications point to a return to that condition. The great change that has taken place, the awakening as it it called, is one of the great events of the world's history. It is an event not to be judged by any short view but to be studied over a long vista of years or generations.

Under the new conditions, the development of China's metal resources is growing and with it comes a restoration of the spirit of her ancient artisans, among them being the foundrymen. A desire to study the metal situation in China, especially in its relation to iron work, in-



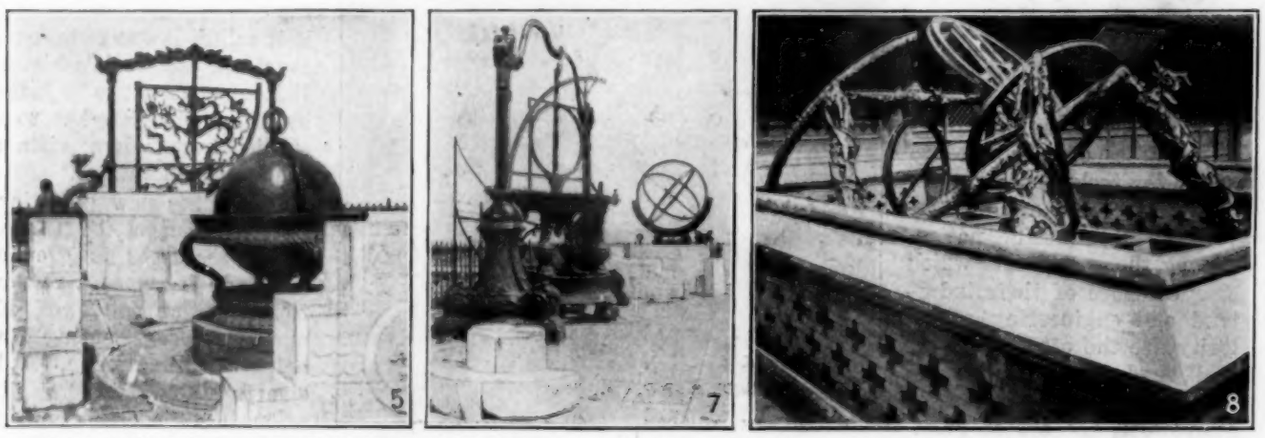
FIGS. 2 TO 4. CHINESE BELL TEMPLE AND BELL.
Fig. 2—Method of suspending bell. Fig. 3—Bell without characters. Fig. 4—The bell tower.

duced the writer to take his camera on a pilgrimage, the results of which are set down here. If the presentation of these scenes and notes brings some beneficial results to China and America by bringing each closer to the other he will be exceedingly pleased. At the least, it is well to see how the other fellow does his work and how he lives.

The magnificent and almost priceless collection of ancient Chinese art in the great National Museum at Peking contains many examples of wrought and cast metal work showing great skill at a very early period in the world's history. Some of the ancient bells in various parts of the country give evidence of the skill attained in casting bronze and iron on a large scale. Numerous large examples indicate that size did not bother them, and complexity of design shows that they had a fine artistic conception which they could carry out successfully in casting.

FIG. 6. INTRICATE AND ARTISTIC CASTING

A large bell outside the city wall of Peking is a notable example of their ability and is considered among the great bells of the world. It was cast by the order of Emperor Yung-lo whose reign began in 1403, and it is housed in an unpretentious-looking building just large enough to hold it. There is a stairway leading to a gallery from which one can examine the top. The whole surface, inside and out, is thickly covered with Chinese characters, averaging about 1 in. square, of the translation of two celebrated ancient Sanscript-Buddhist books. There must be thousands of two celebrated ancient from the surface and sharply cast. Such bells have no tongue but are rung by being butted with the end of a horizontally suspended beam of wood. Fig. 1 shows the side of the bell, and Fig. 2 shows the top and the method of suspension from an immense beam. The material is bronze and the bell



FIGS. 5, 7 AND 8. ASTRONOMICAL INSTRUMENTS SHOWING THE PROFICIENCY OF THE CHINESE FOUNDERS

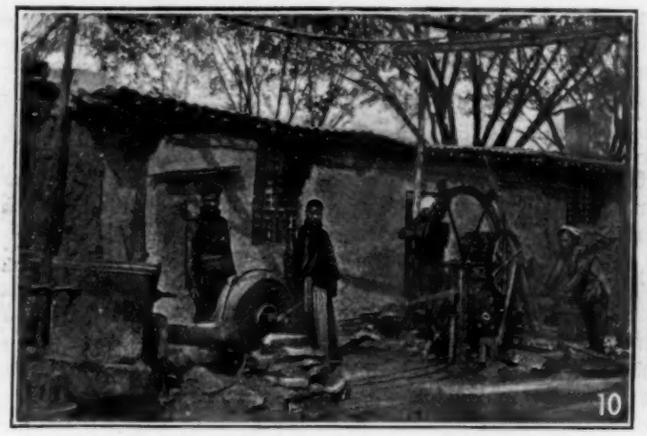


FIG. 10. HAND-DRIVEN CENTRIFUGAL BLOWER

FIG. 11. MAN-POWER WIND BOX

has a diameter of 10 ft., a height of 14 ft. and an estimated weight of 130,000 lb. The surface shows clearly the lines of the joining of the numerous cheek pieces used for the outer surface. This bell is said to be one of five of the same size ordered by that emperor.

There is another of the five in the tall bell tower in the city, Fig. 3, but it lacks the characters on its surface. Aside from the casting of such a bell is the matter of getting it up in the tower and suspending it. How far it was transported is unknown, but in the days of its youth means of transportation were not what they are today, and its placing in the tower represents a great feat of engineering. Fig. 4 shows the tower into which it was raised. It is suspended just inside the upper middle arch.

FIG. 9. MORE THAN LIFE-SIZE WARRIOR

On the east wall of the City of Peking there is a set of astronomical instruments, cast in bronze, which furnishes a fine example of the skill of the ancient Chinese, not only as founders, but also as astronomers and artists. Figs. 5, 6, 7 and 8 are views of some of the pieces. An interesting history goes with these instruments which may be considered as foreshadowing the character of the Hun as exemplified in present-day events. At the time of the Boxer uprising and the siege of Peking in 1900, the Germans stole the original instruments and took them back to Germany. This gross act of vandalism was a great blow to the Chinese, as they have a great veneration for such old relics. On demand for their restoration the Germans refused to comply, but after much pressure had been brought to bear on them, they made exact replicas and mounted them in place of the originals.

Another example of very ancient casting work in iron is shown in Fig. 9. During a recent trip into the interior of the Province of Shansi, the writer visited the very old temple of Chin Ssu, 10 miles from the provincial capital, T'ai Yuan Fu. In the

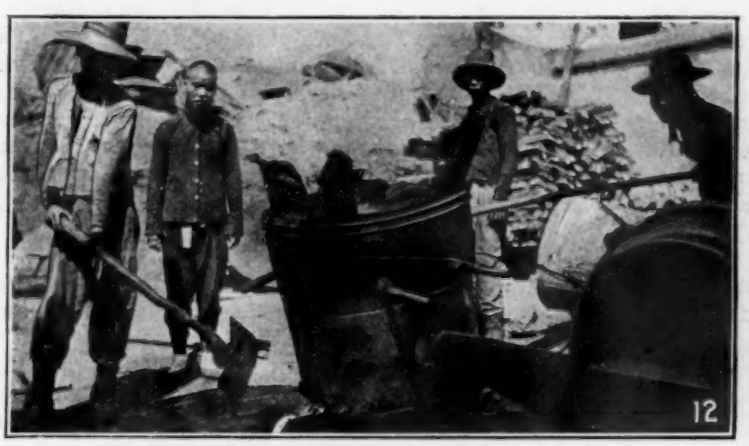


FIG. 12. TILTING THE CUPOLA FOR POURING

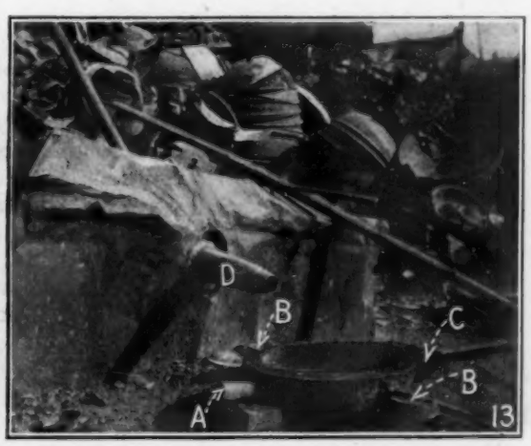


FIG. 13. THE LOWER HALF OF THE CUPOLA

beautiful temple park there is a group of four cast-iron statues of more than life size. One of these, the best one, was made during the Sung dynasty (A. D. 960 to 1127) as shown by the inscription. The workmanship is excellent and the surface has been scraped and polished. The other three are of a much later date and show inferior workmanship. They were made to take the place of others which, for some reason, had been destroyed or removed during some of the stormy and warlike times through which the region has passed.

Present-Day Chinese Foundry Practice

Among the first places visited in search of modern casting work was a foundry in the French Concession in Tientsin. Naturally one expected to see the effects of contact with foreigners and their methods, and the products showed it. They were making things for core sand which just fitted over the ends of the rods or tubing. These were laid in position on the floor and held there by stakes driven into the ground. One or two sets were set up and poured, then quickly taken up and others laid in their place. Whenever possible the molds were made with the ground as the nowel and a flask used for the cope only. In such cases, stakes were driven into the ground on each side as guides for the flask. Wood is scarce in most parts of China and a stock of iron flasks is too expensive for the average foundry, especially at the present time when iron has gone up enormously in price. Snap flasks have not come into general use here except in a few foundries where a continuous similar product is turned out under foreign supervision, as in a few railway shops.

The blast mechanism of the average Chinese foundry would interest and amuse an American foundryman, al-

FIGS. 14 AND 15. UPPER HALF OF CUPOLA AND GANG POURING THE MOLTEN METAL

which, a few years ago, there was no Chinese demand, such as cams, gears and parts of looms and textile machinery, cast-iron pipes, pipe fittings, columns for building purposes, heating and cooking stoves of foreign design, and metal bedsteads. Besides these foreign things, they were making articles of Chinese design and using such as cast-iron pans for cooking, small stoves, axle bearings for carts, plow points, etc.

The foreign stoves were evidently made by taking old stove-parts as patterns, no pains being taken to remove the old lettering. Indeed, it might be more accurate to say that care had been taken to leave the letters on because, to the Chinese, anything like a trade mark or "chop" is greatly valued. Not being able to read English, the merchant depends on the markings on the goods as a guarantee that they are the same as he has had before. Foreigners are not much the losers by such imitation because the types used are mostly very old fashioned and the imported stoves would be prohibitive in price for the average Chinese family. The foreign-made stove is conspicuous by its absence except in a few thickly-settled foreign settlements.

The methods used for making the metal bedsteads were not what could be called labor saving, but the labor was cheap as the dirt used for the molds, being done by boys. The first-class molders did not get over 50 or 60 cents a day (equal, at that time, to 22 or 26 cents U. S. gold), while the boys did not get much more than enough for their food and clothes. Where tubing or rods were to be cast into iron parts, the molds were made in baked

though the one in this particular case showed the influence of foreigners in the vicinity. It was a rotary fan, evidently of foreign design if not of foreign make, but it was driven by a hand-power mechanism somewhat similar to that shown in Fig. 10. At another foundry in Tientsin, it was found that the proprietor had gone one better and installed an electric plant of his own, driven by a compound steam engine designed and built by himself.

Soon after visiting these foundries in Tientsin, the writer had the opportunity of visiting some foundries in the City of Paotingfu. This is a city of at least 90,000 inhabitants, 90 miles southwest of Peking on the Peking-Hankow Railway. It is an ancient walled city, probably not less than 3000 years old and has been subject to very little foreign influence. Several foundries were visited which were carrying on their work by very old methods and doing quite a large volume of business. They used pig iron from the Hangyang blast furnaces, near Hankow, mixing it with plenty of scrap, coke being used for fuel

Foundry Blast Apparatus

In two of these foundries, they used the rotary blast fans operated by hand-power shown in Fig. 10. When in actual operation, they use four or six men instead of the two at the cranks shown in the figure. The flywheel was a marvel of untruth, wabbling in all directions to an alarming extent although keyed tightly to the shaft. The spokes were of wrought iron cast into

FIGS. 16 AND 17. CAST-IRON PANS AND SMALL STOVE

the hub and rim, and had additional weights cast on outside the rim. The gears were rough and the bearings so worn and loose that there was at least ½-in. diametral play.

The Wind-Box Blast Apparatus

Another kind of blast apparatus which is used most commonly is the "wind box" or *fêng hsiang*. This consists of a rectangular wooden box in which slides a closely-fitting wooden piston, operated by a rod coming out of one end of the box. In the lower inside corners of the box are square longitudinal boxes for air passages which have suitable clapper valves at each end so that the piston gives a blast on both the forward and backward strokes, the blast coming out of the side at the middle of the box. The piston, of course, is cut out at the corners to fit over the air passages. Fig. 11 shows such a blast apparatus in action. A detail drawing of this form of blower is shown on page 982, Vol. 36 of the *American Machinist*. Such bellows are used in various sizes all over China, from the tiny one for a tinker's soldering fire, that for the kitchen fires, the larger ones for blacksmith's fires up to these large ones for the foundries and small native smelters. The periphery of the piston is packed with feathers to get as near an air-tight joint as possible.

In using these bellows for the cupola, the stroke is so long that the men have to walk back and forth to complete it. At the end of each stroke, just before returning, they give the piston a sudden jerk in order to reverse the valves quickly. These wind boxes give a good blast and have the advantage of being cheaper to make and keep in repair. The length of stroke is 4 to 4½ ft. and the area of the piston about 750 sq.in.

In all the Chinese foundries thus far visited, except in those directly under foreign influence, the cupolas were of the same type as that shown in Fig. 11. The upper part *A* is a fireclay-lined, cylindrical cast-iron case, slightly flaring at the top, with a hole in the side for the tuyere pipe connection, see Fig. 12. This tuyere hole points diagonally down on the inside of the cupola. The lower part is a saucer-shaped receptacle, Fig. 13, lined with fireclay and fitted with trunnions *B* for tipping the cupola when pouring. The top is luted onto the lower part. In the bottom part there is a socket *A* into which a wooden handle can be inserted for tipping the cupola. Fig. 14 shows the upper part of the cupola removed and turned up side down to show the inner end *A* of the tuyere hole. The iron rods *B* projecting from the sides of the case are handles for lifting it. The lower part is shown in Fig. 13 which also shows the tuyere pipe *D* projecting from the side of the wind box and the lip *C*, out of which the fluid iron flows. The tuyere pipe just reaches to the side of the cupola so that when the cupola is tipped the blast is shut off. Figs. 10, 11 and 12 show the cupola complete and Figs. 12 and 15 show the operation of pouring. The accumulated melted iron is taken off about as fast as it can be produced as the cup at the bottom is small.

The ladles are clumsy and heavy and not as deep as those used in the American foundries. The hand ladles have a socket at the back into which a wooden or iron pipe handle can be inserted. For the largest work a

FIG. 18. CAST AXLE BEARINGS

FIG. 19. CHILLED FLOW POINTS

FIGS. 20 TO 22. POURING AND MOLDING
Fig. 20—Filling plow-point molds. Fig. 21—Casting pigs in iron molds. Fig. 22—Sweeping up the nowel.

two-man ladle is used, but the majority of the work in the Paotingfu foundries called for not more than two small ladles full.

In 1916, these Paotingfu foundries were engaged in turning out cast-iron pans like those shown in the foreground of Fig. 16, very small Chinese stoves like that shown in the foreground of Fig. 17, cart axle bearings like those in Fig. 18 and chilled plow points, Fig. 19.

During the disastrous floods of the summer of 1917, these foundries were all destroyed but have been quickly rebuilt with an enterprising spirit equal to that of Americans under similar trying circumstances. Since rebuilding they have turned their attention to remelting pig iron and introducing their accumulated scrap into it. At one foundry, the mixing was done by pouring melted pig iron into a mold made in the open sand, putting pieces of scrap iron into the partly filled mold and then pouring in more pig iron. At another foundry, the scrap and pig iron was melted together and poured into molds made by laying four heavy interlocking pieces of iron on a base piece, as shown at *A* and *B* in Fig. 21. The new pigs or slabs cool very quickly after pouring, and the molds can be taken apart in a few moments, the slab removed and the mold made ready again. These slabs are very hard iron.

The pans, stoves and plow points mentioned above are of surprising thinness. Pieces of the pans broken out at various places show a thickness in some cases of less than $\frac{1}{16}$ in. in pans 2 ft. in diameter, and $\frac{1}{8}$ in. is above the average thickness. These pans are used everywhere for cooking purposes. The extreme poverty of the common people leads them to practice the greatest economy in fuel. Because of the high price of fuel and the smallness of the stoves, these pans must be as thin as possible, and it is certainly a marvel how much well-cooked food a Chinese cook can get from a tiny fire.

About the first thing that would attract the American molder's attention in investigating the process of making these pans would probably be the nature of the molds. These are made of a material that is strong and heat-resisting and are used over again a great many times. At the same time, the surface of the mold is smooth, producing clean work. It certainly is a process which gives good results without much extra molding labor.

The molding material seems to be a good quality of molding loam mixed with clay and powdered pottery which makes a strong heat-resisting material after it has been baked by burning wood over it. Numerous vent holes are made in the material to let out the gases.

Making Molds for Pans

In making the molds for the pans, the cope and nowel have iron skeleton frames conforming to the shape of the pan on which the prepared loam is swept. In the case of the smaller pans, the nowel is swept up on a hand-revolved table, as shown in Fig. 22. The larger molds are swept up as shown in Fig. 23 which shows both cope and nowel being swept. The projecting handles are cast on the skeleton frames.

Fig. 24 shows the method adopted by one foundry for preparing the powdered pottery. It is pounded in an iron pot or mortar with ball-shaped hammers, three men striking in turn. Fig. 16 shows the method used by their next-door neighbor. It is ground between two

FIG. 27. CASTING SEPARATE BARS IN LOAM

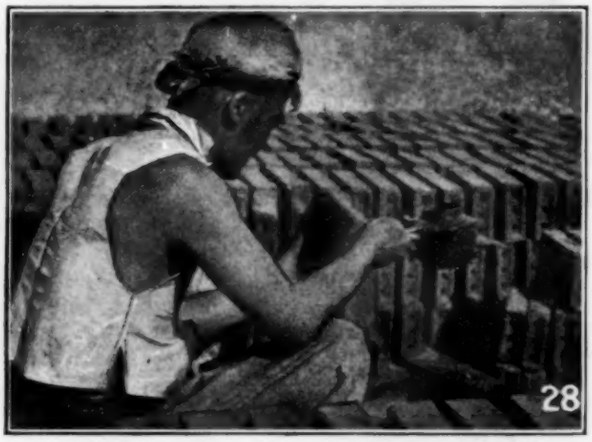
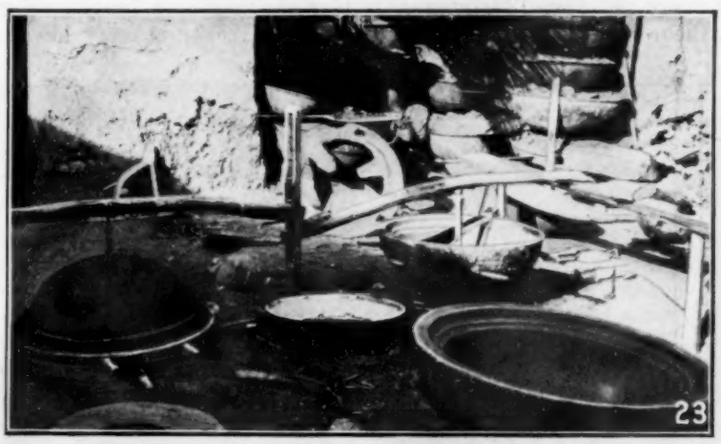
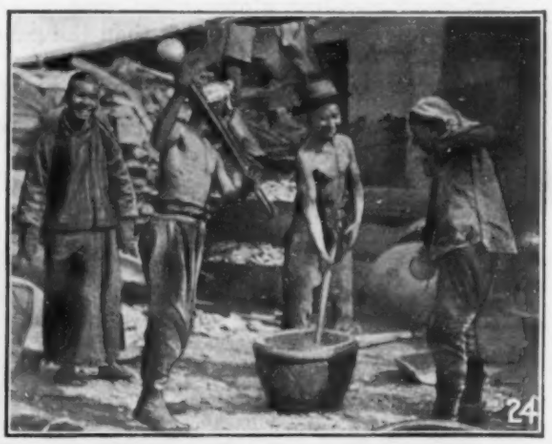
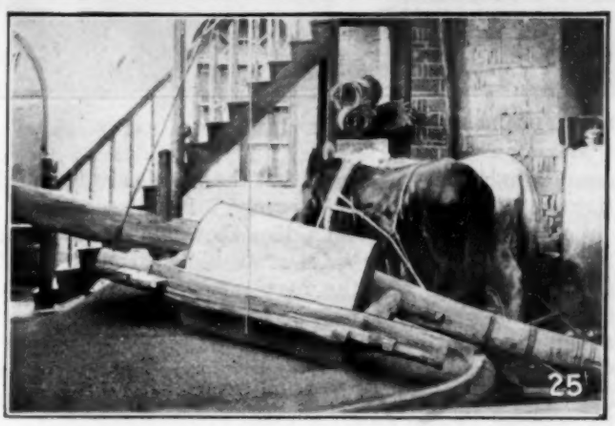


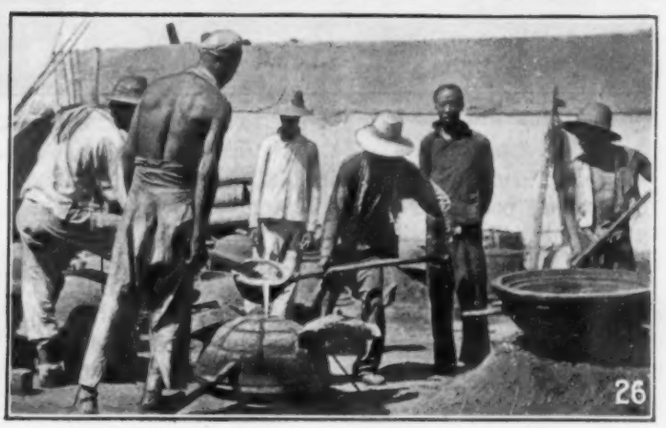
FIG. 28. CASTING SEVERAL BARS TOGETHER AS A GRATE

stones, one a large horizontal base on which the smaller cylindrical one revolves, carried around the center of the larger one in a wooden frame which is pivoted to the center of the base. Because the smaller roll is cylindrical, there is a fractional or grinding action at all points of its length except at a single neutral point. This form of mill is used all over China for grinding all sorts of material, especially grain. Fig. 25 shows the same type of mill on a larger scale, grinding grain in a rather progressive grain shop in Paotingfu. In the same mill they also employ steam power. Thus the old and the new are often found side by side in the land where there are so many complete reversals of the conditions and methods at home.









FIGS. 23 TO 26. IRON FOUNDRY SCENES

Fig. 23—Cope and nowel for large pan. Fig. 24—Pounding pottery. Fig. 25—Grinding pottery in a mill. Fig. 26—Weighting down the mold while pouring.

Before a series of pourings begins, the molds are heated by burning wood over them. The sprue hole is warmed up by a hot coal of coke so as to prevent chilling the iron too much during pouring. When sufficiently warmed, the surface of the mold is given a wash of clay water, the mold closed and weighted with pig iron. For additional weight, they sometimes place bars in sockets made in the cope and stand on them, as shown in Fig. 26. When a pan is so large that it requires two ladles of iron, they are both poured simultaneously so as to maintain as hot and uniform flow as possible.

As soon as the gate shows signs of filling, the pouring is stopped. The men get so expert in judging the point at which to stop that there is seldom any sprue left at all. The pans are usually left a little thicker at the center of the bottom than elsewhere, but the sprue, if there is any, must be removed before the iron looses its red heat because the pan is so thin that it will not stand having the sprue knocked off after cooling. If perceptibly too much iron has been poured a man stands by whose duty it is to remove the surplus iron with a small iron spoon before it cools.

The pans are so thin that they cool very quickly and in one or two minutes the cope is slightly lifted at one side to admit air to hasten the cooling. This is soon followed by the complete removal of the cope. At this stage, the iron is still red hot and only a little below the setting point and if it is discovered that there is too much iron left at the pouring point, it is neatly shaved off with a shovel. If it is discovered that there has been too much iron removed with the spoon and a hole made, the same tool pours on a spoonful from the ladle.

The pan is removed from the dome-shaped nowel soon after it has lost its red heat by inserting a shovel under the edge and prying it up enough for the insertion of three hooks under the edge. The mold is allowed to cool off a bit and then examined for any cracks, chips or other defects. If it is all right, it is again washed with clay water and closed again for another pouring. With a few molds the men can take away the iron from the cupola about as fast as it is melted.

These pans are made in a great variety of sizes up to 6 ft. or more in diameter, the common sizes ranging from 1 to 2 ft. Before the floods of 1917, there were four of these foundries along the bank of the canal near the South Gate, and their product went far and

wide. Although the canal connects with others of the vast canal system of China, thus making it an ideal situation so far as transportation is concerned, it is safe to say that a good part of their product had to be transported on men's backs before it reached its destination farther inland, the means of transportation being utterly inadequate for the needs of this great country. The writer has encountered long lines of porters carrying such freight along country paths, back from the canals, each man struggling along with his load suspended from the two ends of a toting pole across his shoulder. Across the canal from the foundries, there is now a spur track of the Peking-Hankow Railway, which takes away part of their product—a forerunner of the new order of things that is coming in a few years.

The small cast-iron stoves often used under these pans are scarcely less interesting than the pans themselves. They are made thin like the pans and have supporting points to fit the bottom of the pan. The grate is usually a series of loose, round, cast-iron bars. Fig. 17 shows one of the stoves, the permanent mold in which it was made, and the molder who made it. A loam core is used, the circular body of which is swept up and carved out where necessary for the various arms and legs. One mold will make a great many stoves.

The Chinese Plow

Chilled plow points are also made in these foundries. The Chinese plow is a very simple affair, usually entirely of wood except for the chilled point which is driven onto the share beam. The whole plow is so light that when a farmer has completed his day's work of plowing, he can take his plow on his shoulder and walk home with it. The soil of a great part of China is so free from stones that a heavier plow is hardly needed. Ground that has been worked over for a few thousand years is a different proposition from the new American prairie soil.

Fig. 20 shows some of the plow-point molds and the method of tying them together. Like the pans and stoves, these plow points are very thin and are chilled by inserting triangular, pyramidial, iron chills into the molds as cores. Fig. 19 shows some of the molds disassembled, also the chills and some points. These molds are used repeatedly.

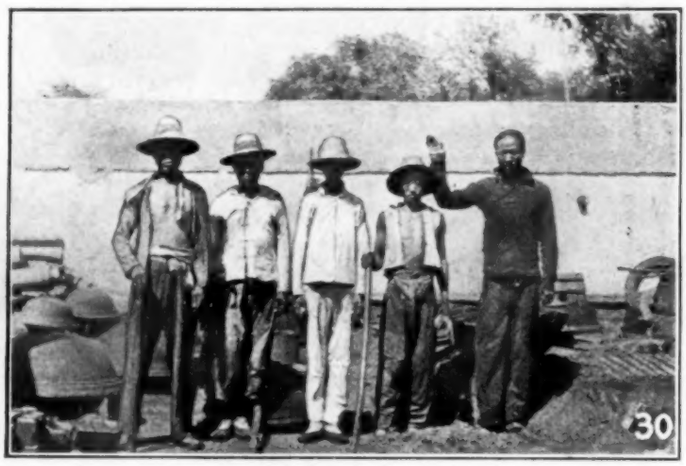
The small round bars for stove grates are for sale at all stores where iron goods are sold and are employed in the brick and clay stoves commonly used in the household. The bars are made in various lengths up to 15 in. or more, the method employed for making them being shown in Fig. 27. A long bank of loam is thrown up and the molds made by thrusting a round stick vertically into it at close intervals until the bank is full of them. Each one is poured separately.

Other Products

Fig. 28 shows a method employed where several bars are cast as one grate. The molder is pouring clay water into them to coat the inner surfaces, then pouring out the surplus water. These molds are set up in a bank of sand, as shown in Fig. 29, for pouring and are not permanent.

Fig. 18 shows a molder making axle bearings for carts. Many of the carts used in the country have a peculiar axle construction in that the wheels are fastened tightly to the axle which revolves in inverted semicircular, cast-iron bearings, like those at *A*, under the body of the cart. The axles are usually large pieces of some hard wood and the carts are almost invariably of the two-wheeled variety. In eight years of travel about the country, the writer has seen only one four-wheeled cart of native make and that one had both axles fixed so that in order to turn a corner the cart had to be dragged around by main force.

In the background of Fig. 18, the core *B* for an iron temple bell can be seen and in the foreground are the cheek pieces *D* for the outside of the mold. The core was swept up on one of the revolving tables *C* and then the scallops were cut out.



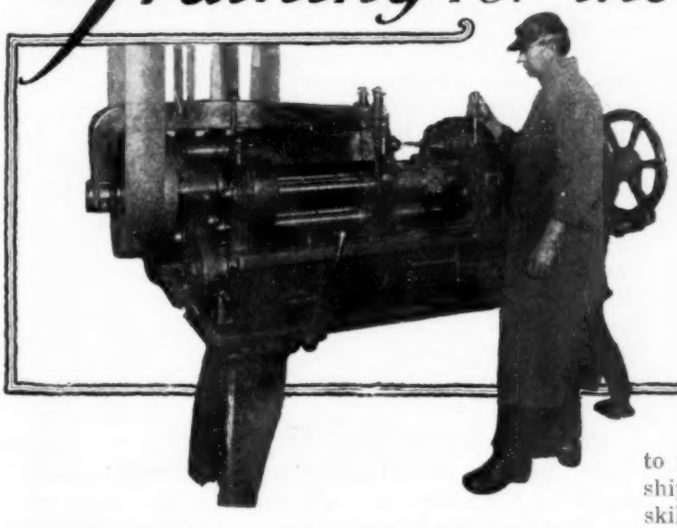
FIGS. 29 AND 30. TYPICAL CHINESE FOUNDRY WORKERS

A Traveling Foundry

One kind of foundry that is probably not often seen anywhere else is a traveling foundry. These itinerant furnaces go about from place to place on huge wheelbarrows in the farming regions, collecting old iron and remelting it into plow points and other implements needed by the farming villages. The permanent molds for such goods come in very conveniently.

The foundrymen themselves are an interesting study and some of them are shown in Fig. 30 which portrays a few of the skilled workmen of one of the Paotingfu foundries and the foreman who has his hand raised as though he belonged to a certain secret society. As a rule they are a resourceful, energetic lot of men.

Training for the Building of Machine Tools



By

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This article gives the principles of training for workers in machine shops and shows how it has been carried out in a well-known machine-tool plant. Summed up, it deals with the elimination of those undesirable or not suited to fit into the production organization; training green workers for simple operations; studying the personnel of the factory with the view to possibilities of upgrading; studying to straighten out the problem of misplaced help. This is not theory alone; it is full of practical suggestions for all managers.

THE war situation has pressed home to manufacturers in a most emphatic manner the fact that the old method of "breaking in" unskilled or semi-skilled workers was inadequate, as well as tremendously expensive from many angles; but particularly so in three ways: from the high cost of supervision; the amount of spoiled work; and the high rate of labor turnover.

It may be safely stated that: "The lower the grade of workers the more foremen or sub-foremen are required." This increases the "non-productive" charge against production account. Spoiled work has always been the bane of the production department because of its cost, but equally as much so because it creates holdups in actual production due to delays in making replacements.

Labor turnover is the manufacturer's necessary evil, but because it cannot be entirely eliminated is no reason why it should not be combated. The writer has heard employment men, who should be in a position to know, say: "We lose men out the back door of our factories faster than we can get them in through our employment bureaus."

As a matter of fact some money is spent on "breaking in" every one who comes into a plant that makes them more valuable to some one else as well as yourself. How many figure up what this item amounts to in labor turnover each year, or have intelligently tried to reduce it?

Some few men, even before the war, had found the training of workers to be a possible solution of this problem but it remained for the stress of war conditions to apply the necessary pressure and force men in all lines of manufacture to "set their houses in order" if they were going to meet the demands alike of the Government and the conditions of intensive production.

References to training and instruction do not allude to the work as carried on in the trade or apprenticeship departments organized for making apprentices or skilled workers but deals particularly with that branch of intensive training which was so successfully applied by the Emergency Fleet Corporation in the shipyards; by the large steel plants; by munition, airplane and automobile factories. The general principles of this training may, with various modifications, be used to advantage by the smaller manufacturers under present reconstruction conditions.

There has never been any real logical reason or excuse for the old way of "breaking in" men except that every one else was doing it that way. Some men were considered "better" simply because the men they were turned over to had a little more knack for teaching or more pride in thoroughness. But no analysis was made to find out why this was true, nor was this natural ability to teach made to serve a larger and fuller purpose. Training, whether intensive or otherwise, does require primarily that the one who is to impart the knowledge or skill must be qualified for those duties. How evident it is in our shop experience that our best foremen, who are essentially qualified to organize and carry through production work are, because of lack of patience or other qualities, not able to teach even a simple job. On the other hand there are in every shop, no matter how small, men or women who stand out conspicuously because of their ability to impart to another what they possess of knowledge or skill. This person has the most essential qualification of an instructor. Given one who thoroughly knows his trade or branch of the business and who possesses this aptitude to teach, you have a force in the factory which would be infinitely more valuable in instructing than in producing.

It is generally true that the management of our factories does not know the capacity of their personnel in this respect, nor do the individuals possessing these qualifications know the best way to become of value as an instruction force. Uncle Sam, in the form of the

United States Shipping Board of the Emergency Fleet Corporation, made a very definite effort to get the best results from these instruction qualities in the shipbuilding program in both the steel and wood shipyards.

This corporation was faced with the problem of using large numbers of people on work with which they were entirely unfamiliar and to secure a rising line of production in the shortest possible time. Comparatively speaking, only a few men were trained shipbuilders and many of these, while they could do the work themselves, could not get the work out of others. The plan as worked out was to select from among these men, who were masters in their own lines, certain ones who showed indications of ability to give to others what they themselves knew, or could do. These men were placed for six weeks under instructors who knew the art of teaching and by a most practical short course of intensive pedagogy and psychology were made into trained instructors. The pedagogy had for its purpose to show them the proper methods of "putting over" to another their knowledge or skill; and the psychology was to show them how to analyze the operations of their learners' minds for the one purpose of causing them to think through each job as well as do it. In other words, the *why* as well as the *how* of each job.

To give them the instructor's viewpoint, these men were started in the direction of arranging their jobs in a sequence best calculated to overcome the learners' difficulties and give the most immediate results in production consistent with the accuracy required and the smallest possible amount of spoiled work. The men thus trained were made responsible for training green men along their own special lines.

In my own experience, a group of four green men was turned over to one of these new instructors to be trained for riveting and caulking on a steel ship. One of these men was a candy maker, another a paper hanger; the other two were common laborers. The candy maker in four weeks was able to do a most commendable job on driving button-head rivets, although not quite up to average speed of the experienced man. In six weeks the paper hanger was able to do the general run of the caulking of straight water-tight seams and do it well. The laborers in the same time were made reasonably proficient in riveting and caulking work where their services counted to advantage, thus relieving experienced men for the higher grades of work. None of these green men could build a ship with six weeks training but they could do some one or two operations well, and that was all that was required of them.

Training In a Machine Shop

The New Britain Machine Co., like most manufacturers of the country, was faced with large Government orders and a great scarcity of the kind of help needed to do the work. Training our workers was resorted to with the view to relieving the situation in the shortest possible time.

The start was made in August, 1918, and one floor of a separate building 50 x 150 ft. was set apart as a training center. A director of training was secured and a careful survey of the situation made.

The following plan of organization was decided upon: (1) Selection of instructors; (2) careful study of the labor turnover; (3) selection and installation of machinery and equipment.

(1)—Selection of Instructors—The selection of these instructors was made with the utmost care from among our best mechanics who in addition to known ability as workmen showed evidence of ability to pass it on to some one else. How we selected these men may be of interest.

On instruction from Mr. Hare, the production superintendent, each foreman handed in a list of the men they considered competent for this work. It was made plain to the foremen that this was no chance to unload their undesirables or play favorites but their own ability to judge men was at stake. All 35 of the men thus recommended were interviewed by the director and 10 eliminated for various reasons but principally because the men themselves requested it; some were afraid of themselves; some preferred their present job, etc. The remaining list of 25 was presented to Mr. Hare who from his own knowledge of the men or that of the superintendent eliminated 15 more.

Gets a Four-Weeks' Course

The remaining 10 men were given a four-weeks' course similar to that used in the shipyards. Special emphasis was given in this course to impress on these instructors the great value of studying out each job from the standpoint of the difficulties which the learner has to encounter and which he (because he had done the job so often) is very likely to forget or to think unessential. Care is also taken to insist that jobs given be considered from the standpoint of sequence of the learners' difficulties from the simplest to the most difficult.

For good reasons two of these trained instructors were returned to production work in the shop and the corps of the training department consisted of a director and eight instructors of broad experience on the following machines: Lathe, milling machine, grinding machine, drilling machine, shaping machine, planing machine, and boring machine; also instructors on assembling and deep-hole drilling.

(2)—Study of the Labor Turnover—The training department is conducted to meet the labor needs of the New Britain Machine Co. only, and in order to do this effectively, a careful study was made of our labor turnover with the view, if possible, to remove some of the causes. Green workers were found to be the main cause and instruction is shaped to remove much of this difficulty. The fact that many were formerly taken in who were not fitted for our kind of work, will be more and more overcome through the training scheme and many steered into other channels before they become a part of the factory organization. In other words, we are confident that training will help greatly in preventing the drone, the incapable and other equally undesirable forces getting into the factory or at least reduce the number of this kind employed.

(3)—Selection of Equipment—Coupled up with the labor turnover and the decision to train for various particular activities, is the determination of what machines are best suited for the purpose. It is our opinion that a few machines selected to meet actual needs to start with, and these added to as the direction of training may change or be enlarged, is likely to give the best results.

It is here that a description of the equipment of one training department for one line of work will help another plant carrying on an entirely different activity but very little. For instance, a plant wishing to train employees for power-press work would not use a single

machine deemed absolutely necessary for our training department. Similarly, training for a knitting factory it would be foolish to use power presses.

Equip your training department only for your own needs. A small shop with a few machines set aside for training purposes and under a competent person qualified for instructing, may meet your needs just as well as our rather general equipment of machines and men has accomplished our ends. Special emphasis is given in our training department to intensive training of operatives for drilling, milling, lathe turning, cylindrical and tool grinding, bench work and inspection.

Machines Used to Train Workers

Our product consists of a large variety of machinery including automatic screw machinery. To train workers for its manufacture the following machines were set aside at first: 5 lathes, including a Lodge & Shipley, and Jones & Lamson turret lathe; 1 shaping machine; 1 planing machine; 3 milling machines; universal, plain and hand type; 4 grinding machines; 2 cylindrical, 1 internal and 1 cutter type; 1 wet tool grinding machine; 2 drilling machines; 1 sensitive and 1 thirty-inch vertical type; 1 Bullard double-head boring machine; arbor press, speed lathe, centering machine, power hacksaw, 75 ft. of benches with vises, and a tool crib with small tool equipment.

The following machines were added as the requirement arose: 2 lathes; 1 shaping machine; 3 drilling machines, 2 sensitive and 1 fifteen-inch vertical type; 1 Barnes tapping machine; 1 Lucas boring machine; full equipment of shop furniture.

Everyone who goes through this department is given instruction in accurate measurements with the scale to 8th, 16th, 32nd and 64th; the use of inside and outside caliper measurements; how to read and get the feel of the micrometer; and the reading of simple blueprints. This is done in a most practical manner and in connection with the kind of work that the learners will actually do when they go into the factory. In the case of those going onto the inspection of our finished product, this training is carried even further to include vernier measurements, concentricity tests, etc.

The actual instruction on machine operations varies, according to the individual and the work to be done, from two days on simple drilling to six weeks or longer on lathe turning, shaping, milling, etc. To make sure that the newcomers get the best chance possible on the job for which they were trained, and furthermore to overcome the nervousness which everyone naturally feels in new surroundings, the instruction in the training department gives way to a period of training under the same instructor on the actual job and machine in the factory.

This feature, like the instruction, varies in length of time to meet the needs of each particular case. This has impressed some who have studied our "school" as a radical departure from accepted methods and as a rather risky proposition. With us it has proved of real benefit.

The foreman is, by this arrangement, relieved of all responsibility for new help until they are fitted to their new surroundings. Foremen have shown their appreciation of this arrangement by asking these same instructors to give added training to their learners when the foremen were too busy to change them over on new jobs or operations. The instructors, because of their interest in the development of *their* students, take kindly to the suggestion.

Giving Men Three Chances

To avoid as far as possible the misplacement of the newcomer in our organization, each one is "tried out" on at least three different kinds of machines, some on the lathe, milling, and shaping machines; others on lathe, grinding machine, boring mill, etc. Where they show plainly no aptitude for acquiring mechanical skill, we advise them to go into some other line of work. Where special ability is shown on some particular machine or operation, intensive training is applied along that line. In other words, every possible effort is made to fit square plugs in square holes and round ones in round holes.

While much study is given to specialization, we carry on with it the purpose to up-grade the men as well. The men who show loyalty to the organization and who do conscientious and consistent work will be given opportunity to advance and will be trained for the highest position they can occupy. A good helper who shows interest and head work, will be given a chance to learn how to operate a machine. A good plain milling-machine hand who has demonstrated his worth to the firm in this work will be given the necessary instruction to become a universal milling hand with corresponding increase in wages. In the rush of our war work, this principle was carried out by giving two of our best toolmakers the chance to become tool inspectors and men from the production work advanced to toolroom work.

One result hoped for from the application of this principle is a stimulus all along the line due to the men understanding that the top is open to anyone who has the ability and interest to work to attain it. This means continually training men and women for higher types of new activities wherever this training can be applied to the mutual advantage of employee and company. In one instance where a special job in assembling had to be rushed, instructors were placed at vital points and the new men instructed while the production was being forced up. In another instance, where a group had been trained for only a single operation on a special job, those who showed up best in interest and production were returned to the "school" for a longer period of training on lathes, milling machines, shaping machines, etc. In other words, the training department is made as elastic as the needs of the factory demand and the instruction personnel broad enough to fit into every niche.

Some of the Results

Several gratifying results have been obtained in the brief time we have run the training department.

The seeming pleasure with which former students return for additional instruction shows that they feel that they have a friend in the training department.

Men who are earning as high as 40c. an hour on some special line of work in the factory are asking for a chance to get into the "school" for broader training even when they know it means six weeks or more at 25c an hour with no definite assurance of more than their original rate of return.

Foremen are asking for "trained help."

A splendid spirit of coöperation exists between the various departments and the training department both as to furnishing work for training purposes and taking the operatives who have been trained.

A further appreciation of the work of the department came with the signing of the armistice. The management at once ordered its continuance as a peace-time measure and directed that the activities be adapted to the reconstruction period. To accomplish this, additional equipment was added and the instruction, which was directed to war contracts, is being gradually evolved to fit the needs of our general product.

It is not the purpose to outline in detail our course of instruction but simply to point out a few of the basic principles which we consider absolutely essential to good instruction along any line of mechanical work. The most important of these principles are:

Demonstrate fully and carefully what you want the learner to "get."

Don't try to teach too much at one time; too big bites of food swallowed whole gives indigestion; too big bites of information gives mental indigestion and creates mental confusion and spoiled work.

Take time enough to observe and be sure the learner understands every point shown him in the demonstration.

Check him up by questions while he is doing the job to be sure he is *thinking through his job* as well as doing it. If he gets the "why" of the job he will be more likely to understand his next job of a similar kind.

Test his work to be sure he continues to get it right. *Don't assume he knows; know* that he can do the required job *right*.

Grade the jobs from simple to complex so that each successive job will add some learning difficulties. This should be worked out carefully on paper by the instructor before teaching is begun; he will then be less likely to forget some of the important points that should be covered.

Does It Pay

The question is frequently asked: "Does your training department pay for itself?" The work in this department goes a long way toward "paying its way," but the basis of this work is training, not production. All work done in the department is production work and the learners are brought as quickly as possible to the general standard of production; but the work done is a by-product of training. The real test of our department is not how much work has been turned out but how thoroughly is the man or woman trained to do work to the required degree of accuracy and with the minimum of supervision, when turned over to the factory. We contend that it is very expensive to "break in" workers in the old way, and that it is an uncertain quantity when you have it fitted to your needs. We expect to reduce this cost through training and at the same time develop our workers in such a way that they will stay with us in increasingly large numbers and for longer periods of time

Another question often asked us is: "Do you have a course of exercises to give this gradual progression in instruction?"—No! we try to keep the theoretical ideal always before us but we give instruction and training only on actual production work. We get from the factory the kind of work that comes nearest what we think is the ideal; this is the instructor's job and requires planning and thought. The "old way" was to give the man the first job that came along whether his former experience had fitted him for it or not.

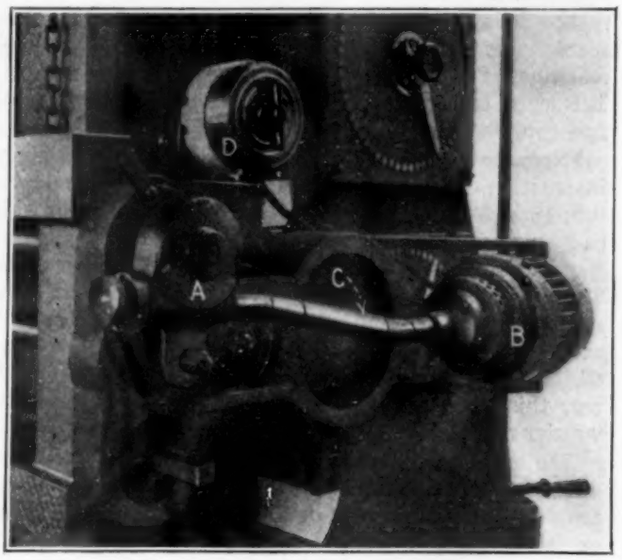
In conclusion, I would state that we are not running a "school" because others have done or are doing so. The New Britain Machine Co. is running its training department the same as every other department in the factory is conducted, namely, to assist in the general scheme of making our product the best that it can be made and as economically as possible, consistent with our reputation for making a standard line of machinery. We believe that it pays to have trained employees instead of a stream of those who are green or untried.

If we have succeeded at all in our purpose in training it is due very largely to the hearty coöperation which obtains throughout the plant. It has its directing impulse in Charles Hare, the production superintendent, who believes in training from the ground up; and it finds a sympathetic response in the foremen who have shown a splendid willingness to give the idea a fair trial.

Power Traverse Attachment

In order to conserve the energy of the skilled planing-machine hand, the Lucas Machine Tool Co., Cleveland, Ohio, has designed and built for its own use, the power traversing attachment illustrated herewith for moving the head on the crossrail of their 46 in. x 60 in. x 20-ft. Gray planing machine.

This consists primarily of the housing *A* which carries a worm and wormwheel, the latter having a square



POWER TRAVERSE ATTACHMENT FOR PLANING-MACHINE HEADS

hole in the center which fits easily over the squared end of the crossrail feed screws. The worm is driven by the small motor *B* through the shaft *C*, which is equipped with two universal joints. The motor is controlled by the snap switch *D*, making the whole thing extremely convenient to handle. The housing has a projection *E* with a round hole which is so spread as to slip easily over the adjoining shaft and tends to steady the housing when in use.

The attachment can be used on either of the three crossfeed screws and the motion is readily reversed by simply turning the housing over so that the projection *E*, as well as the worm, is on top of the wormwheel.

This device has been particularly useful and can, with only slight modification, be put to a variety of uses.

Turbo-Gear Manufacture

By E. A. SUVERKROP

This mechanism is of the planet and internal-ring gear type and is comparatively light in weight. The material and workmanship of such a gear must be of the highest quality to meet the rigid requirements of the manufacturer and user. Throughout the manufacture, the working tolerances have purposely been made smaller than necessary. This has more than proportionately reduced assembling difficulties and costs.

THE line drawings, Figs. 1 and 2, show the general construction of a new turbo gear built in a number of sizes by the Poole Engineering and Machine Co., Baltimore, Md. It is a self-contained mechanical power transmission for installation between the prime mover and the driven unit, to both of which it is connected usually by means of flexible couplings. The shaft *A* is a heat-treated alloy-steel forging. Formed integral with *A* is the double-helical pinion *B* which meshes with the three double-helical planetary gears *C*. The planetary gears *C* are also made from alloy-steel forgings heat-treated. They are bushed with bronze and run on the planet pins *D* which are rigidly secured at both ends in the cage *E*. The cage *E* is made from two steel castings, the larger of which appears at *A* in Fig. 5. It will be noticed that at one end there is a stem and at the other three projections. The smaller casting *B* in this illustration is the cage plate *G*, Figs. 1 and 2, which is secured to the three projections by tap bolts *F*, making the planet-gear housing practically a single piece and affording a support for both ends of the planet pins. The cage plate *G* has a central projection which runs in a ball bearing, while at the other end of the cage is the low-speed shaft *H* also running in a ball bearing. Thus the cage is supported in bearings at both ends. The inner end of the high-speed shaft is supported in a bearing *I* in the cage. This bearing carries practically no load, as the pinions *B* and planet gears support it. Rigidly keyed to the housing is the gear ring *J* with which the planet gears engage. Contained within the housing is the lubricating pump *K* which draws oil from the reservoir in the bottom and distributes it to all bearings and gears. Located in the lubricant tank is a cooling coil *L* through which the water circulates. This gear can be used either to step up or step down. Speed ratios of the high- and low-speed shafts as great as 19 to 1 are obtainable in a single gear. With gears in series; that is to say, with the low-speed shaft of one turbo gear hooked up to the high-speed shaft of another turbo gear and so on, there is no limit to speed ratios.

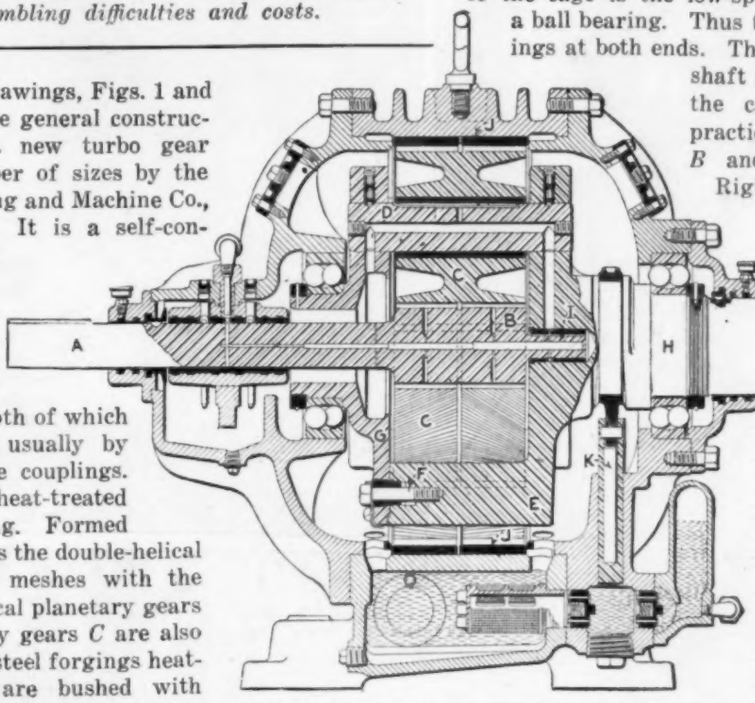


FIG. 1. FRONT ELEVATION OF TURBO GEAR

The entire mechanism, with the exception of the

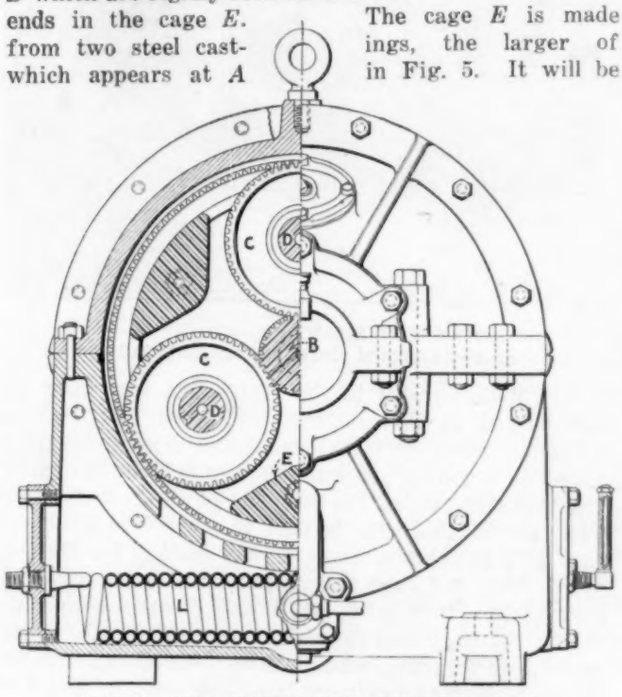


FIG. 2. END ELEVATION OF TURBO GEAR

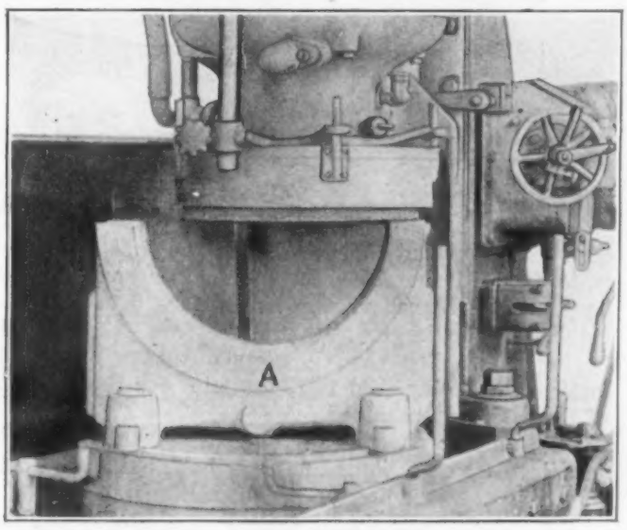


FIG. 3. FACING JOINT AND FEET ON GRINDING MACHINE

coupling ends of the high- and low-speed shafts, is inclosed so that the device can be used in wet or dirty locations without injury.

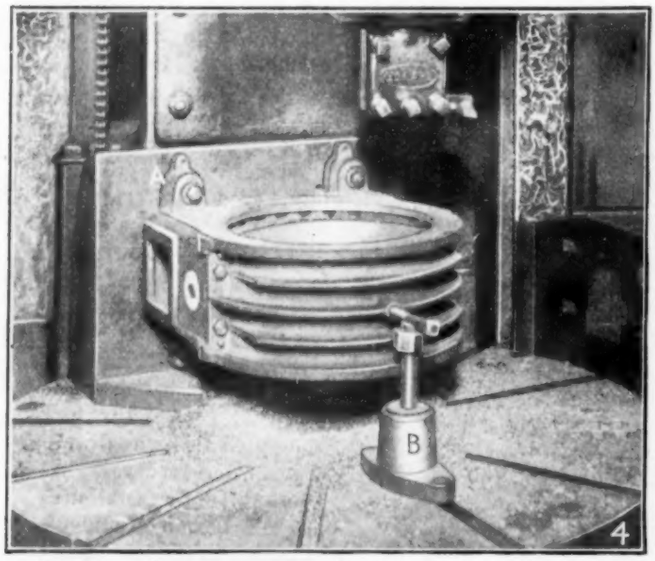
Brake tests of every unit are taken before shipment and the efficiency runs from 98 to 99 per cent. The high-speed shaft of even the larger units can be readily caused to rotate by grasping the low-speed shaft and turning it by hand alone. The ability to do this vouches for the efficiency of the device and the excellence of the work.

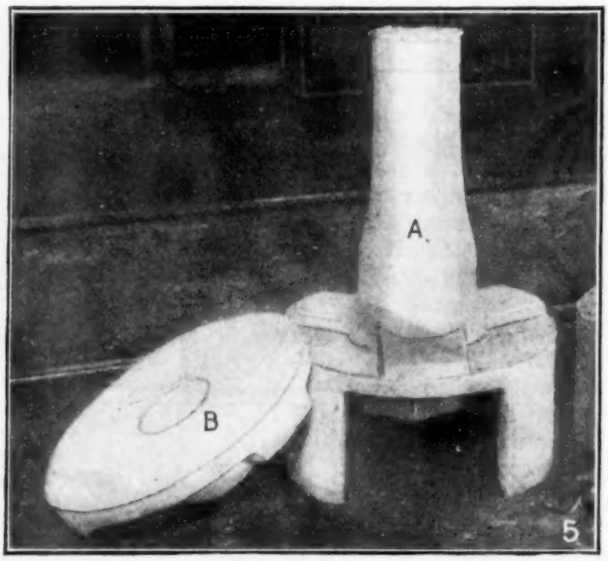
The casing is made up from iron castings produced by the foundry of the plant. The lower half of the casing is shown at *A* in Fig. 3. The first operation is to face off the feet. In the smaller sizes this is done on the Blanchard vertical surface grinding machine. In the larger sizes the feet are faced in the boring mill. The casting is then turned over and, locating by the finished feet, the joint for the top half of the casing is machined.

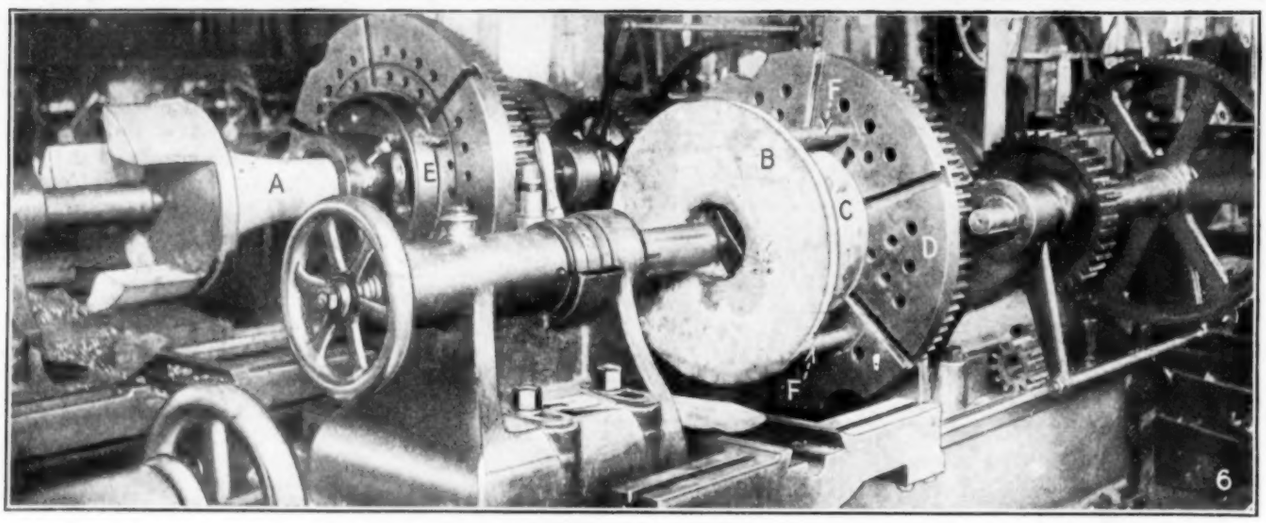
In a similar manner the top half of the casing is machined where it joins the lower half, but a jig holds it during the grinding or boring-mill operation.

The bolt holes are next drilled in a simple jig, the two halves are bolted together and taper steady-pins are inserted to positively prevent shifting of the parts. This excellent practice of steady-pinning parts together is employed wherever advisable throughout the construction of the turbo gear.

After bolting the top and bottom of the casing together, it is bored and both ends faced. Owing to the rapid development and the demand for a wide variety of sizes it has been impossible to "jig up" the entire job. For this reason some of the jigs and fixtures are those which could be most easily and quickly made. One of these is shown in Fig. 4. It is a simple angle plate *A* with a jack *B* as an outboard support. The feet of the casing are flat and if the angle plate is square the bore will be parallel to the feet. The two faces are also turned at this setting, the upper one with an ordinary facing tool and the lower one with a tool set at an angle in the end of a bar held in the turret. The tolerances on all the essential parts are very small. The bore in this case is held to —0.000 +0.0005 in. In Fig. 5 are shown, at *A*, a steel casting for the low-speed shaft and cage and at *B* a steel casting for the cage plate. In Fig. 6, at *A* and *B* respectively, are shown the cage and cage plate in the lathes. Except as regards accuracy, which allows +0.000 and —0.0005 in., it is just an ordinary lathe job. As is usual the steel castings are rough and have an excess of metal







FIGS. 4 TO 6. WORK ON THE CAGE AND LOW-SPEED SHAFT

Fig. 4—Boring and facing casing. Fig. 5—Castings for the cage. Fig. 6—Low-speed shaft and cage plate in lathe

on them for finish. All castings with blow-holes are rejected, for to obtain running balance in the completed mechanism the individual parts must be in proper balance.

The low-speed shaft *A* is held at the faceplate end by a spider plate *E*. The cover plate *B* is held in a four-jawed independent chuck *C* bolted to the faceplate *D*. Three pins *F*, 120 deg. apart, are threaded into the faceplate *D* and locked with nuts at the back. The faces of these pins are turned off to bring them to equal height. They then form distance pieces to facilitate chucking the work.

After the low-speed shaft is finished so far as possible, including a steadyrest spot in the setting shown in Fig. 6, the shaft is removed from the lathe.

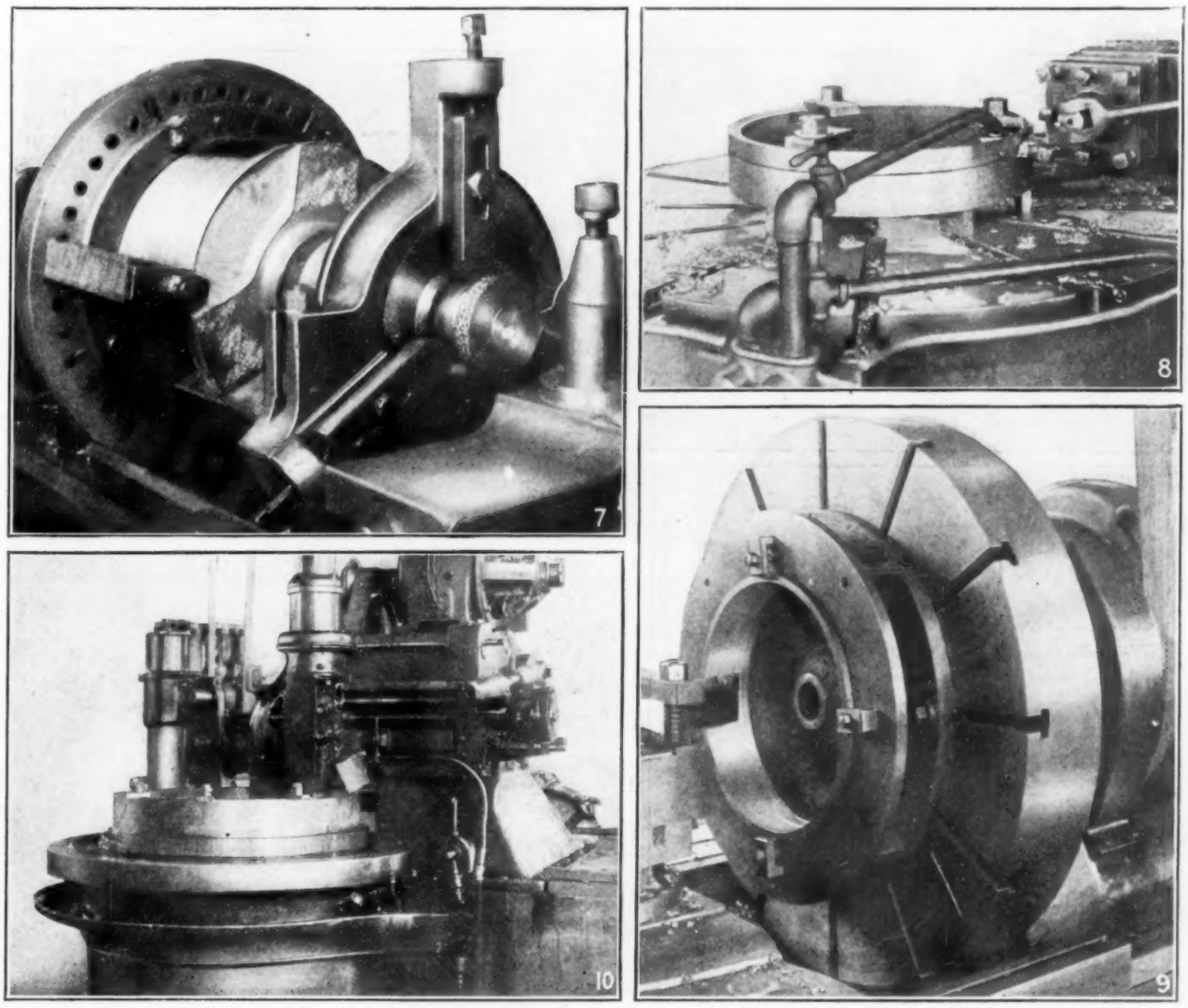
The pronged end of the casting is located in a true fitting in the faceplate of a lathe, the other end is run in the steadyrest and the end of the low-speed shaft centered as shown in Fig. 7. The shaft is rough-turned and the end drilled and tapped. This tapped hole is used later to draw the coupling on when installing the gear. The eccentric for the oil pump is rough-turned direct on the shaft at the enlarged part near the flange. The cage plate is now attached and the whole assembly is turned between centers to assure that the journals on both ends of it are in line.

The ring gears are from 6¾ to 25½ in. in diameter or larger, and are made from forged rings of 0.25 to 0.30 carbon steel. They are rough-turned all over and then heat-treated. After the heat-treating process, they are chucked very lightly and one end is faced entirely. The other end is faced as far as possible without the tool coming in contact with the chuck jaws. The next operation is to clamp the work by the faces so as not to distort them and turn the outside as shown in Fig. 8.

The rings are next bored, using a fitting either on the Bullard mill or the lathe as shown in Fig. 9. Clamping, as before, is done by the faces only. The tolerance on the ring is about 0.001 in.

The internal gear rings are cut in the Fellows gear-shaping machine shown in Fig. 10. This machine is a special large machine, of which two were built, and will handle work up to 48 in. in diameter by 9½-in. face 4-5 pitch.

The Poole Engineering and Machine Co. built the frames and the Fellows Co. supplied the mechanisms.



FIGS. 7 TO 10. TURNING SHAFT, TURNING, BORING AND CUTTING GEARS
Fig. 7—Turning end of shaft. Fig. 8—Turning gear ring in Bullard mill. Fig. 9—Boring gear ring in lathe. Fig. 10—Shaping teeth in gear rings

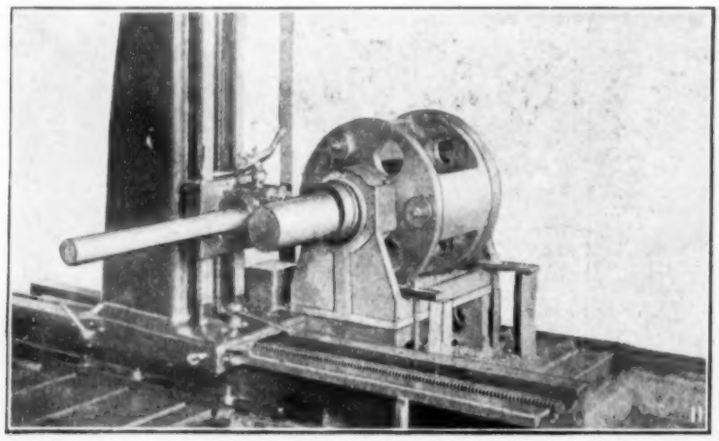
In this operation the ring is centered in a fitting and clamped as before by the faces.

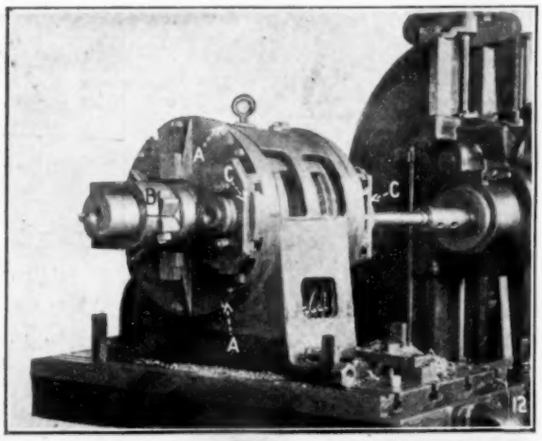
As previously stated, the job is not entirely jigged up yet. In Fig. 11 is shown the boring of the planet pin holes in one of the larger turbo gears. In this case a simple holding jig is used in combination with a horizontal boring machine. There is, however, no indexing mechanism, compelling the operator to set the work for each hole. In Fig. 12 is shown the same job on a smaller-sized unit for which a jig has been provided. Notches *A* are provided for the indexing member to drop in. The hub of this member is shown at *B* clamped to the low-speed shaft. The bushing plates *C* can be adjusted to and from the center of the fixture to provide adjustment for the various sizes of units which this jig can accommodate. Either with or without the jig it is required that the holes must be equally spaced 120 deg. on the circle within 0.001 in.

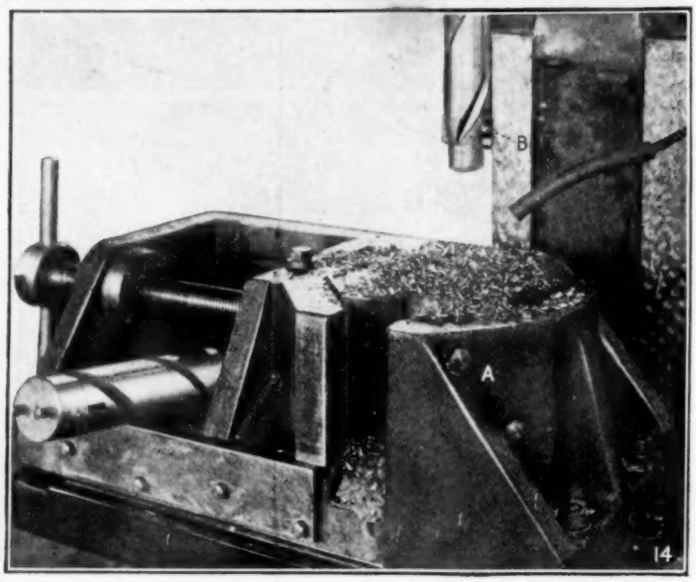
In Fig. 13 are shown various sizes of planet-gear forgings. These are made of 0.40 to 0.50 carbon alloy steel. The first operation is to bore and rough-turn all over. This was formerly all done in the lathe, including recessing the grooves in the ends. The rough-boring and recessing is now done on a Colburn heavy-duty drilling machine shown in Fig. 14. The work is held in the heavy vise *A* and pierced with a twist drill. This machine will drill a 2-in. hole 7¼ in. deep in 5 min. The boring tool *B* is then passed through the work. It will be noticed that there is an angle formed on the top of the flat cutter; this and the helical grooves in the boring bar lift the chips from the cut. The planet gears are grooved on the ends to lighten them.

This operation formerly in the lathe took from 2 to 3 hours with a single-pointed tool. The job is now done in the Colburn drilling machine with the tool shown in Figs. 15 and 16 in from 15 to 20 min. This size of tool cuts a groove about 3 in. deep and 1⅝ in. wide at the top. The body is made of machine steel pack-hardened. The band on the outside is machine steel shrunk on. The cutters are high-speed steel. The cutter *A* removes the metal from the center, *B* from the inside and *C* from the outside of the groove. After roughing out, the planet gears are heat-treated and then finish-bored. A bronze bushing is now forced in and bored, after which the outside of the gear is finish-turned and ground to a tolerance of +0.000 —0.001 in.

The teeth are cut in the Fellows gear-shaping ma-







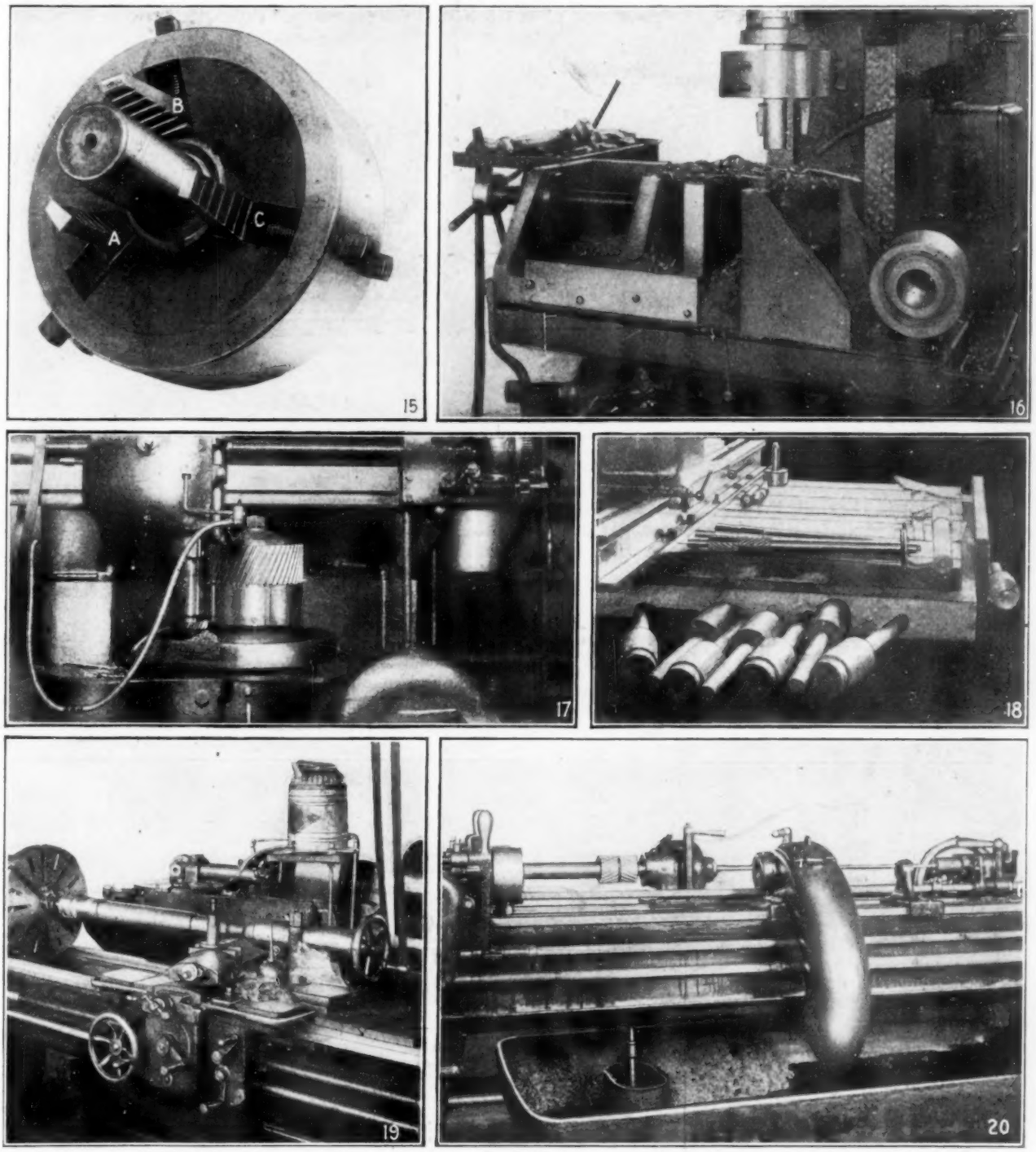
FIGS. 11 TO 14. OPERATIONS ON THE CAGE AND GEARS

Fig. 11—Boring planet pin holes. Fig. 12—Jig for planet pin holes. Fig. 13—Planet gears rough and part finished. Fig. 14—Boring the centers of planet gears.

chine, as shown in Fig. 17. It will be observed that the teeth of one-half are finished and work has been started on the other half.

As previously stated, the high-speed shafts and pinions are forged as a single piece. Some of these are shown in Fig. 18. These are also of alloy steel. They are first roughed out and then heat-treated. They are then finish-turned between centers as shown in Fig. 19. From turning they go to the grinding machine and are ground all over; the teeth are then cut in the Fellows machine. The oil hole in the shaft is drilled in a Pratt and Whitney gun-drilling machine, as shown in Fig. 20. Six small radial oil holes are drilled, three in each half of the pinion. The holes are 120 deg. apart and staggered so that the oil is distributed over the whole face of the pinion. In Fig. 21 are shown high-speed shafts, ring gears, planet gears and planet pins on the inspector's bench where they are being given a hardness test with the scleroscope.

Three planet gears go to a set. In order to insure



FIGS. 15 TO 20. TREPANNING, GEAR CUTTING, TURNING AND GUN DRILLING

Fig. 15—The trepanning tool. Fig. 16—The trepanning tool and work. Fig. 17—Cutting teeth of planet gears. Fig. 18—High-speed shaft forgings. Fig. 19—Turning high-speed shafts. Fig. 20—Gun drilling oil hole in high-speed shaft.

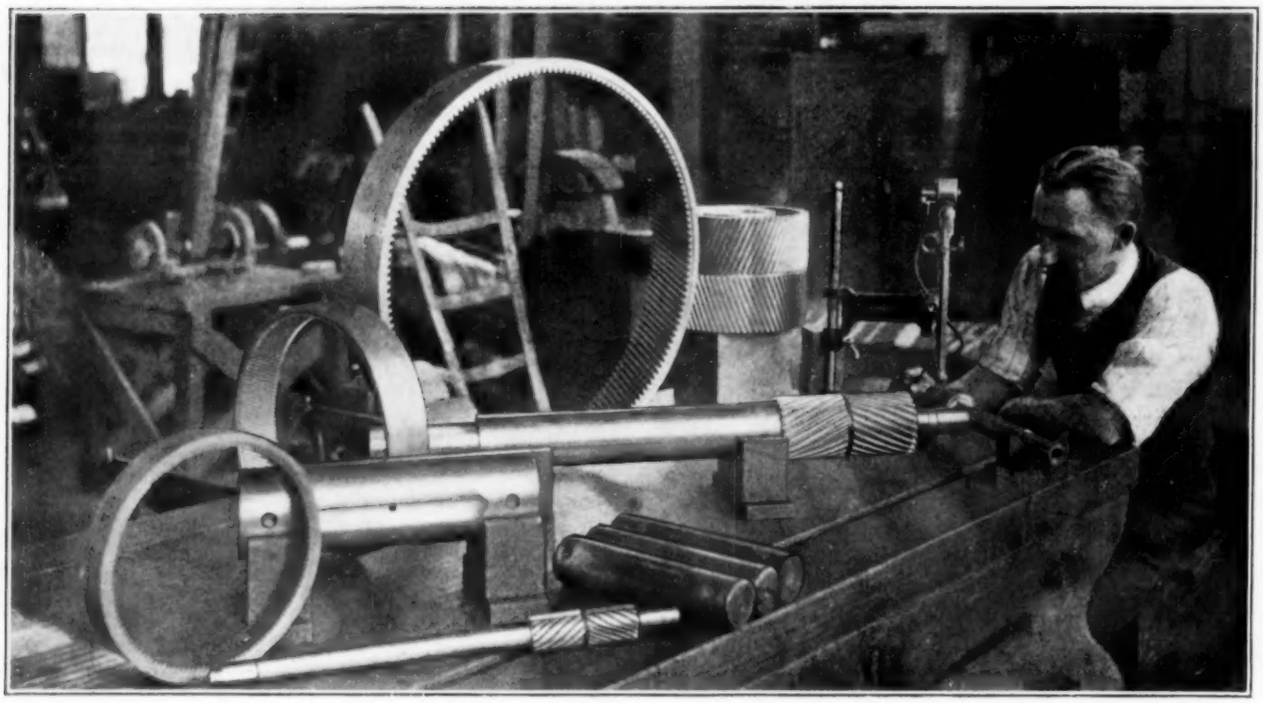


FIG. 21. THE SCLEROSCOPE TEST

perfect balance in the unit, the three must be the same weight within a small fraction of an ounce. If one or two of them are heavy the excess is removed from the grooves in the ends.

The relative positions of the high-speed shaft planet gears and ring gears are shown in Fig. 22, where one planet gear has been left out of the assembly so that the illustration would show the pinion. At *A* is shown one of the keys which prevents the gear ring from rotating.

In Fig. 23 is shown a turbo gear reduction direct-connected to a Terry turbine, the rotors of which are shown at *A*. The ring gears are shown at *B;* the cage plate is shown at *C;* the high-speed shaft at *D;* the planet gears at *E*, and the low-speed shaft at *F*.

After assembly each turbo gear is run in for several hours after which it is given an efficiency test, using a prony brake as a load.

As previously stated, even the largest of these units can be readily turned by hand. This is not so difficult to believe if one considers that the high- and low-speed shafts are in line within very close limits, that all tooth pressures of the helical gears are balanced so

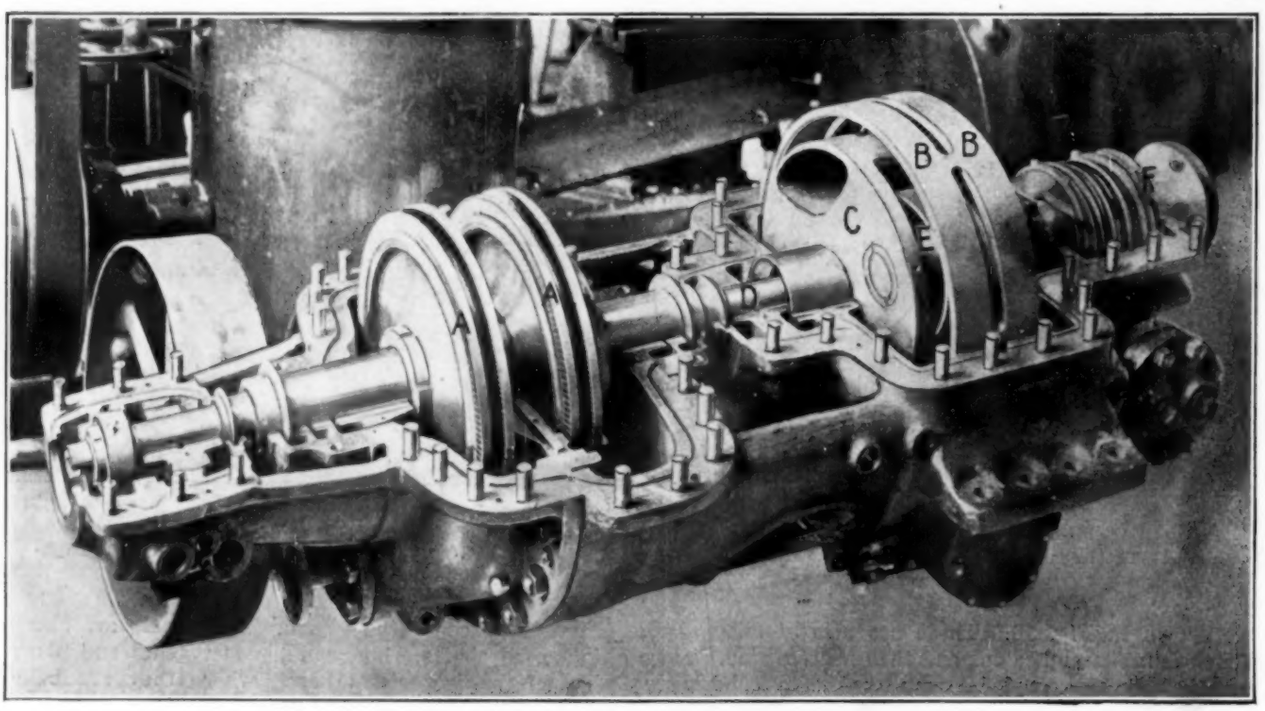


FIG. 23. TURBO REDUCTION GEAR DIRECT CONNECTED TO A TERRY TURBINE

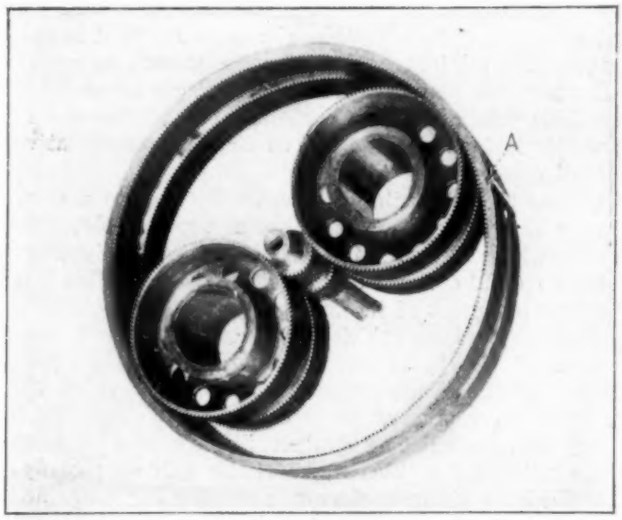


FIG. 22. RELATIVE POSITIONS OF PINIONS, PLANETARY GEAR AND RING

there is no tendency to deflect the shafts and that the bearings merely have to support the weight of the rotating members. All rotating parts are given a running balance test before and after assembly.

Hoisting Device for Boxed Machinery

The handling of boxed machinery is often quite a problem, the use of slings sometimes being rather difficult, with the added danger of their slipping toward the center of the packing case. The device shown in Fig. 1 is extensively used in the plant of the Ford Motor Co. and does away entirely with the use of slings under the case.

It consists simply of a loop of wire cable carrying two jointed hooks, the face of each jaw being provided with 16 substantial spurs, as shown. The way in which this type of sling is used is shown in Fig. 2, the jaws being placed opposite each other over the top of the case so that the action of hoisting sinks the spurs into the boards of the case as shown. It is of course necessary to have the case strongly constructed against crushing when being handled in this way, but the rapidity with which this clamp works and the freedom from danger makes it very desirable for this purpose.

The Cost of Supervision and Overhead

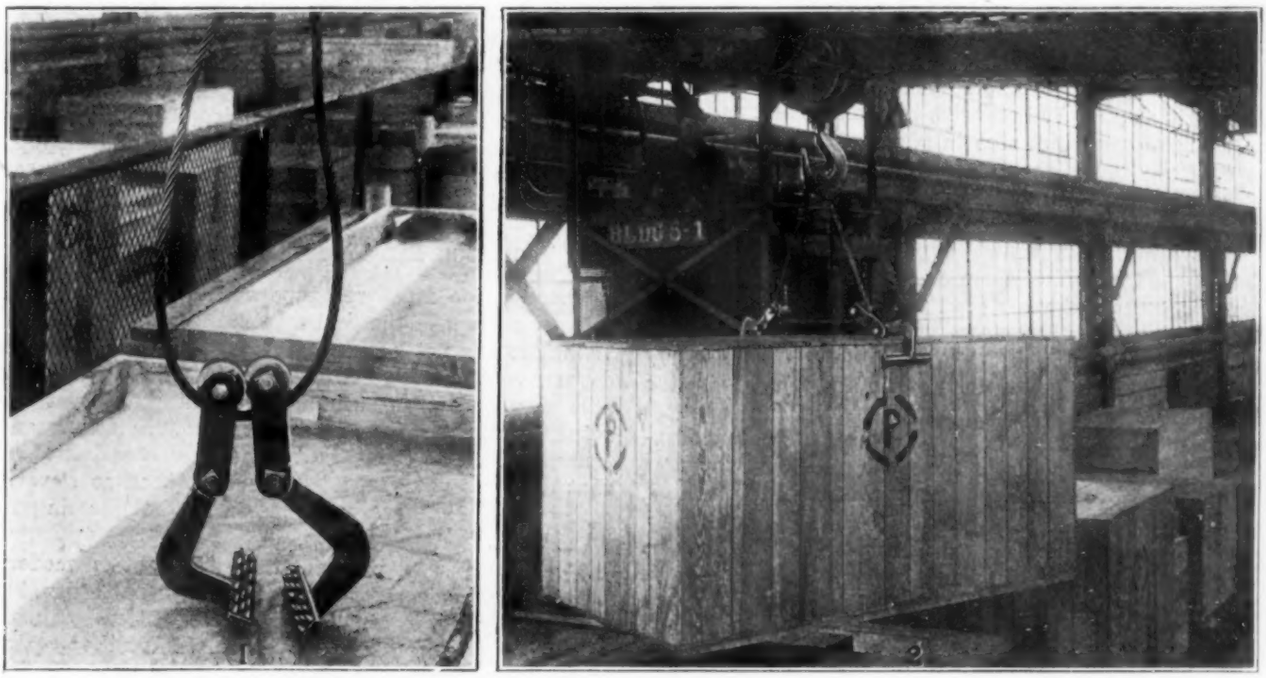
BY HARRY SENIOR

There is an excellent article on page 1221, Vol. 50, of *American Machinist*, in which Fred H. Colvin tells us what becomes of that part of the gross income of our large industries that reaches neither the producing force in the form of salaries, wages, bonus, or other manner of distribution, nor the owners in the form of profit.

The channel through which much of this money disappears is variously called "overhead," "burden," "general expense," etc., and citations in the above-mentioned article from the practices of several large firms serve to show that this channel is divided and sub-divided into sundry outlets tagged with names to suit the ideas and convenience of the individuals having this matter in charge.

The example given by Mr. Colvin from the system followed by a "well-known machine tool company of the Middle West" is typical of the way in which the various items of expense are arranged and accounted for in general practice, the details varying slightly with different firms and the amounts assigned to the specific items depending to a considerable degree upon local conditions. This "overhead" or general expense represents the excess which every "producer" must earn above his wages in order to enable his employer to pay him.

Now, Mr. Colvin says, "in the day of the small shop there were fewer problems of every kind than face us today;" and this statement, unqualified, must be ad-



FIGS. 1 AND 2. THE CLAMPS USED AND HOW THEY WORK

mitted, but if the present-day shop has more *legitimate* problems in *proportion to the relative volume of business* than confronted the old-time small shop there is something the matter with our calculations.

The little old shop under the hill had its problems of "overhead" to meet just the same as at present, though very likely the "old man" wouldn't have recognized the designation. The many items that harass the modern business man were, with a few important exceptions, the cause of keeping the ancient one awake nights.

Interest on Investment

The tax-collector came around just as often and was just as importunate as now. Interest on investment (if the capital was borrowed) had to be met with startling regularity—7 or 8 per cent, too; insurance premiums had to be paid; tools and buildings had a regular habit of becoming the worse for wear, and somebody had to stop "producing" long enough to fix 'em. Nothing could be sold "second-hand" for the price one paid for it, and though quite likely the old man couldn't have spelled "depreciation" correctly and wouldn't have known what it meant if he could, you can bet your boots he was wise to everything about depreciation except what to call it. It took power to make the wheels go 'round, and heat in the winter to keep the men's fingers limber. The men, not being cats, had to have a light to enable them to see after dark. The old man sometimes discounted his customers' notes and he frequently put on his hat and went over to Farmer Jones to "get a little something on account," though he probably never thought to charge his time to "collection expenses."

The Working Foreman a Mistake

In short, the little shop of yesterday did *not* run itself, opinion to the contrary notwithstanding. To be sure the owner, between times of chasing up new orders, running down delinquent debtors, figuring up the payroll and borrowing the money at 9 per cent. to cover it, used to roll up his sleeves and pitch in with the boys, but I seem to recollect that in the columns of the *American Machinist* of 30 years ago we agreed that the "working foreman" was a mistake and hailed the day of the boss with the boiled shirt and time to think as a distinct step in advance.

We have today cheaper power, heat, light and raw material; we have one foreman handling a hundred or more men, against the old man's ten or so; we are supposed to have immensely superior facilities for transacting business, all of them capable of saving us money (if you don't believe it read the advertisements), and we certainly have incomparably more efficient tools and methods of production.

Taking all this into consideration and figuring by the law of simple proportion, the ten-thousand-employee shop should be more than a thousand times better earning proposition than the little old ten-employee shop. Why, then, has the cost of supervision and overhead risen so far out of proportion?

We installed the starched-front foreman because he and his gang could produce more value in a given time than the gang could when one of its members was foreman. In some cases we reduced the number of working hours because "a man can do more work in eight hours than he can in ten"—a somewhat startling proposition; but one doesn't have to be very old to remember the time when it was accepted by many as true. We put more money into buildings because it "paid in the long run." We built and equipped elaborate offices of mahogany and plate glass because it "gave us prestige with our trade," and by enabling us to increase our trade, it incidentally enabled us to lower our relative cost of production.

One of the latest things that we did was to assume that brains and manual skill were incompatible; that a man who could do a job well could do it only when someone (who couldn't do it) told him how. This was the starting point of the modern system of efficiency—the incubator from which was hatched the "efficiency engineer," the "planning engineer," the "estimating engineer," the "routeing engineer," etc.; likewise the "advertising engineer," "sales engineer," "lighting engineer," and "ventilating engineer;" all of them adding their mite to the "overhead." Soon (if not already) we will have oiling engineers, sweeping engineers and engineers for the removal of garbage.

I do not agree with the quotation from Mr. Colvin's article which says that the superintendent of old was to be recognized by being the "dirtiest man in the shop." The author of that statement must be a good deal older than I—and my whiskers are gray—or else his lines have been cast in very different places. When I was a kid, a good way to recognize the superintendent was to go to the shop half an hour or so before starting time in the morning or an equal length of time after quitting time at night; he would be the only man on the premises. Now he comes in about nine, puts his feet on the desk and reads the morning "Courant" or whatever it is, and then begins to get ready to go out to lunch.

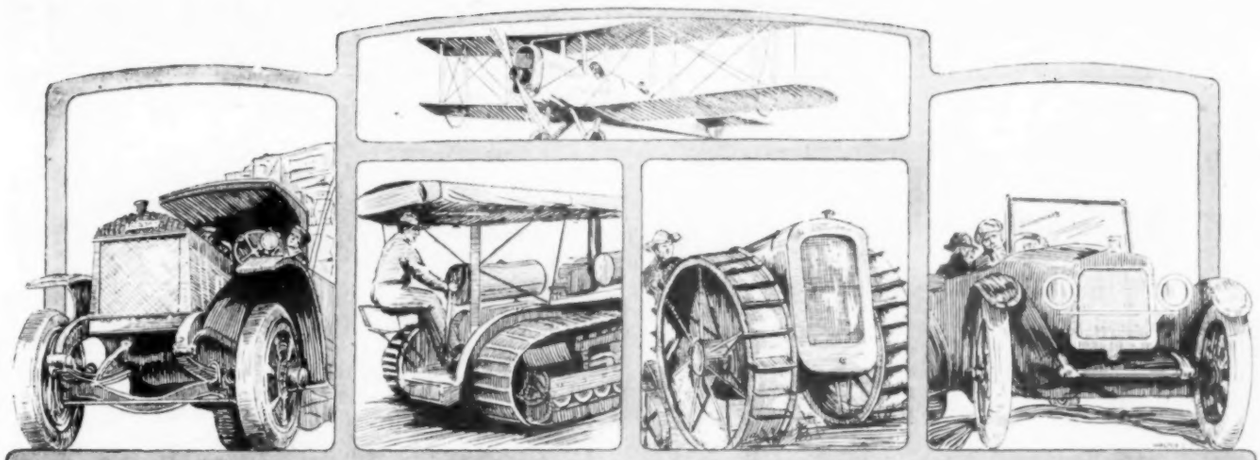
I think something other than mere ignorance on the part of the working force in respect to modern methods of doing business is the underlying cause of our lack of efficiency—for despite all our high-sounding phrases, the real thing is chiefly conspicuous by its absence—though I am willing to concede that education along this line will prove beneficial; it may throw light in unexpected places and enlighten more than the worker.

Mr. Colvin touches lightly upon "the absentee proprietor" and upon watered stock as possible factors in the high cost of doing business. Also, he mentioned the shop whose New York or Chicago office contains more people than the shop which supports it, and it is my opinion that he is here striking dangerously near the root of the trouble.

Too Much Red Tape in Modern Business

There is too much red tape about modern business and not enough of the "old man's" directness of action. While we are not supposed to institute new executive departments or open new offices unless there is reasonable assurance that such a move will "pay," yet the returns from too many businesses show in dollars and cents, or lack of them, that something has been done that does *not* pay and its losses have been so cleverly camouflaged that everybody seems to be guessing at what it is.

By all means, let us turn the searchlight on modern business methods. Let us explain them so thoroughly that nobody, not even ourselves, can be fooled by them; for possibly within them lie the reason for the greater part of the excessive costs of living and much that is responsible for the "spirit of unrest."



AUTOMOTIVE CONSTRUCTION

The Hispano-Suiza Airplane Engine—IV

By H. O. C. ISENBERG
Works Manager Wright-Martin Aircraft Corporation, New Brunswick plant

With a sufficient stock of drags, cheeks and copes completed, the preparation and making of the complete molds is merely an assembling job. It is, however, a very particular one and requires rigid attention to detail to insure the production of perfect castings, as this article will show.

IN FIG. 42 the drag *A* is shown in place on the platen *B* of the assembling machine. This machine has two stationary guide pins *C* which are rigidly secured in the baseplate. Between these guide pins and below the platen *B* is a hydraulic cylinder, the ram of which connects with the underneath side of *B*. It will be observed that there are two transverse holes *D* near the tops of the guide pins *C*. These are for the reception of cross-pins on which the individual mold sections can rest after they are lowered by the crane onto the ends of the guide pins. The hydraulic ram is then operated and the platen *B* elevated. As the lug *E* is less in depth than the flask, the cross-pins in the holes *D* can be withdrawn as soon as the platen lifts the weight of the flask from them. The mold is then lowered to the bottom where it occupies the position shown at *A* in Fig. 42. The barrel cores *F* and strainer cores *G* are ready for plac-

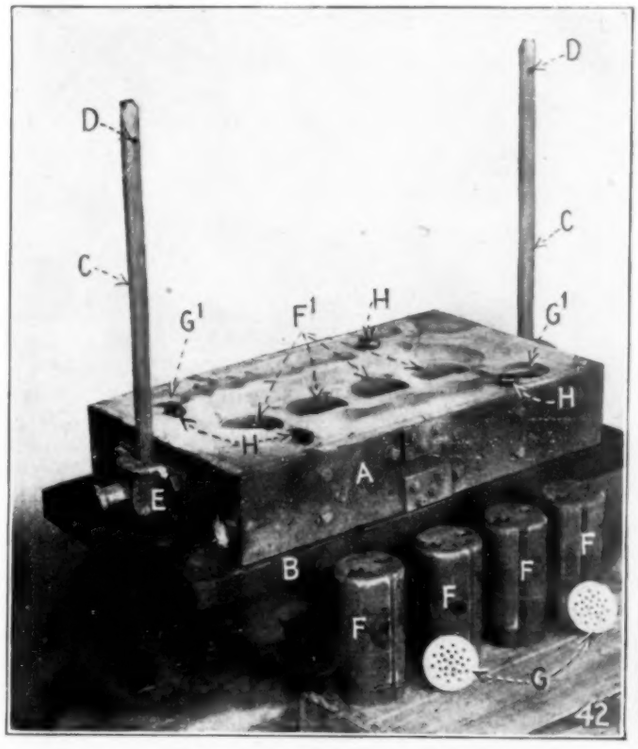


FIG. 42. DRAG MOLD ON ASSEMBLING MACHINE

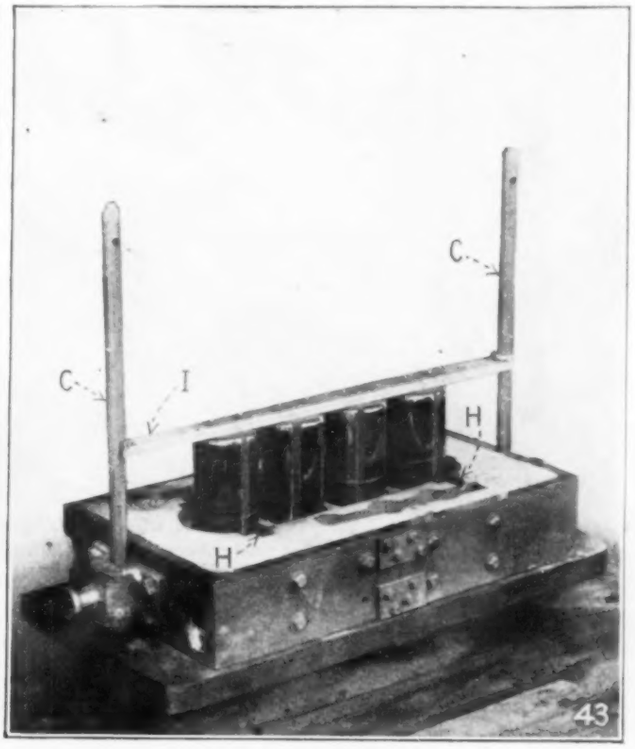


FIG. 43. SETTING THE BARREL CORES TO GAGE

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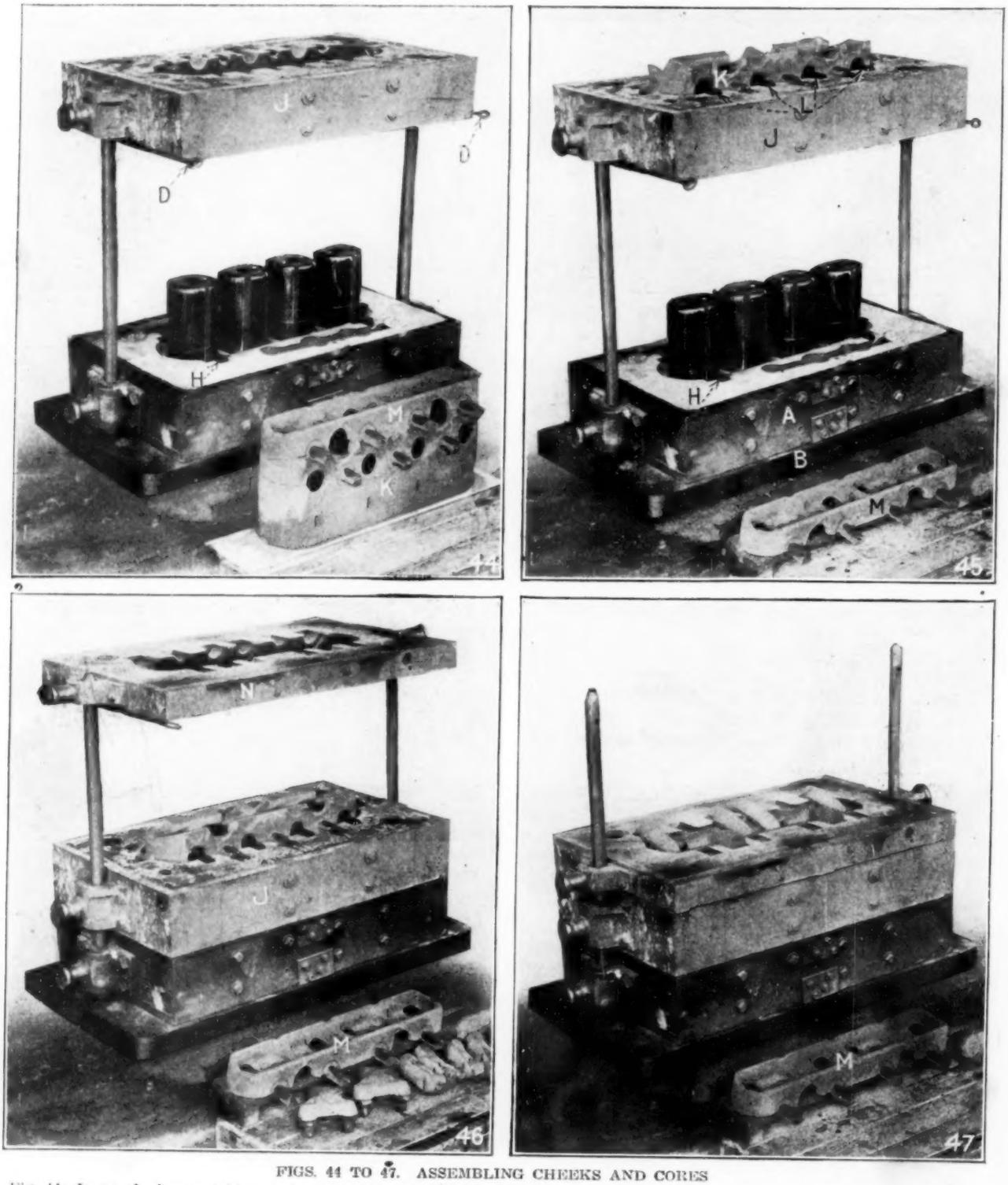


FIGS. 44 TO 47. ASSEMBLING CHEEKS AND CORES

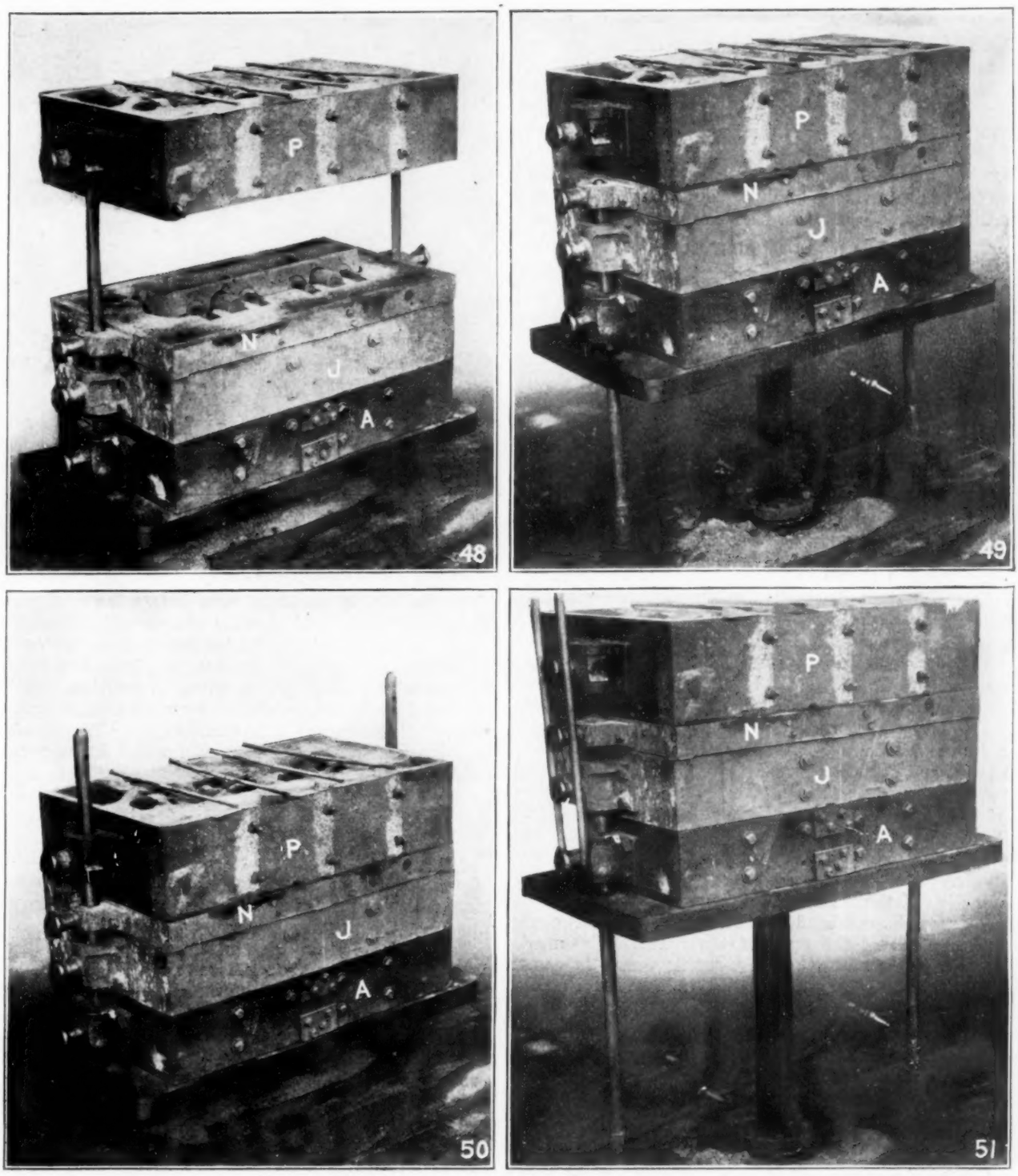
Fig. 44—Large cheek on machine ready for placing water-jacket core. Fig. 45—Water-jacket core placed. Fig. 46—Small cheek ready for assembling. Fig. 47—Drag, large and small cheeks assembled

ing in their respective positions *F'* and *G'* in the drag. Before placing them the assembler boss carefully blows out the mold. As previously stated the barrel cores are placed in iron bushings in the drag mold so as to assure accurate setting.

At *H* are shown four small water inlet and outlet chills. These are in reality metal cores but their action is also to chill and condense the metal around them. They are tapered about 15 deg. where they enter the casting which facilitates their removal from the completed casting.

After the strainer cores and the water inlet and

AUTOMOTIVE CONSTRUCTION



FIGS. 48 TO 51. MOLD FROM FINISH-SETTING OF CORES TO READY FOR THE SHAKING-OUT FLOOR

Fig. 48—Mold with all cores set and ready to close. Fig. 49—Mold closed. Fig. 50—Mold ready for pouring. Fig. 51—Mold assembly and casting ready to be taken to the shake-out floor

outlet chills are placed, the barrel cores are set as shown in Fig. 43. It will be noticed in Fig. 42 that there are two round openings in the tops of the barrel cores *F*. These are for the reception of bosses on the under side of the locating gage *I* shown in position in Fig. 43. The gage *I* locates the barrel cores accurately with relation to the guide posts *C*. The whole drag mold is now thoroughly sprayed with crude oil.

The gage *I* is removed and a tent of heavy light-colored manilla paper placed over the drag to prevent dirt falling into the horn gates and other parts of the drag. Light-colored paper is used as it reflects

AUTOMOTIVE CONSTRUCTION

the light from the sides upward so that when the large cheek is placed on the guide pins it can be readily inspected.

The use of the pins *D* is shown in Fig. 44, where the large cheek *J* is shown resting on them and ready for placing the water-jacket core *K*. The lower part of the core is placed in the large cheek while it is in this position. The core can thus be accurately located and the assembler, by sighting through from the top to the light-colored paper tent below, can see that it is so.

THE WATER-JACKET COIL

In Fig. 45 the large water-jacket core *K* has been placed in the large cheek. The metal spark-plug chills *L*, which are cores similar to *H* are also placed. The core prints in the mold for *L* and *H* are longer than the chills which are located properly by the assembler and the extra length of the print in the mold filled with molding sand, allowance being made for the escape of the gas from the mold. The head core (upper part of water-jacket core) is shown at *M*.

After the core *K* is placed the operator watches both sides of the mold for loose sand. The paper tent is removed, the platen *B* and drag *A* are raised by the hydraulic ram until the large cheek *J* is raised, the pins *D* are withdrawn and the drag and large cheek lowered to the position shown in Fig. 46. The small cheek *N* is shown in this illustration resting on the pins *D*. The intake and exhaust cores are shown. The hydraulic ram ascends, the pins *D* are removed and the drag, large and small cheeks lowered to the bottom as shown in Fig. 47. When in this position the intake and exhaust cores are placed, after which the head core *M* is placed completing the covering of the cylinders as shown in Fig. 48. The cope *P* is now placed on the pins and the mold is ready to close. The operation of closing is shown in Fig. 49. The ram now descends and the completed mold assembly rests as shown in Fig. 50. When in this position it is poured. Two ladles are used at opposite corners and the pouring is done very rapidly.

In Fig. 51 the mold has been poured and is raised. The crane is overhead and the links placed over the trunnions at the ends of the flasks. The mold is now transported to the shake-out floor and the completed casting appears as shown in Fig. 30 at the beginning of this series.

Cooling Camshafts

On account of its length and comparatively small diameter, it is quite a problem to prevent a camshaft from springing during heat-treatment and the subsequent cooling. In order to avoid springing, provision is made for dipping the camshaft straight down into running water as shown in the accompanying illustration. This is a sort of standpipe of perhaps 12 in. in diameter with a larger volume of water flowing up through it and over the top into the tank shown in the illustration at the top of the next column.

The hardener removes the camshaft from the furnace, and with tongs on the end plunges it straight down into the center of this pipe. The large volume of flowing water cools it quickly, and, when it is nearly cool, it is removed from this pipe and allowed to finish

COOLING THE CAMSHAFT

cooling in a tank of oil. As a result, camshafts spring very little during heat-treatment.

This heat-treatment takes place before the final machining operations, and in order to prevent the hardening of the parts which must be machined in the final finishing, these parts are first copper-plated and then wrapped with asbestos paper wired in position. This was found to be more satisfactory than relying upon copper-plating alone, as is frequently done. This represents the practice of the Locomobile Co., Bridgeport, Connecticut.

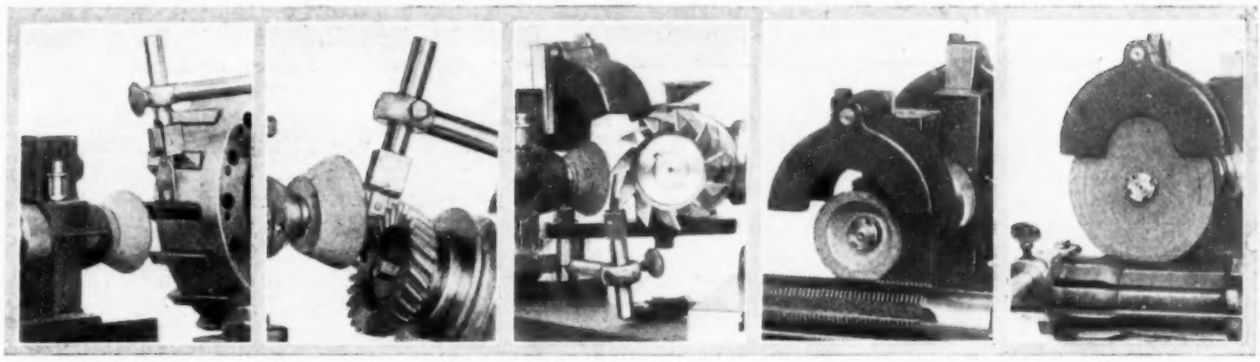
Relieving the Sides of Pistons

BY FRANK C. HUDSON

One of the more recent developments in piston construction is the plan of relieving the sides of the piston outside of the piston-pin bosses so as to form an oil pocket which aids in lubricating the piston pin and also offsets any tendency of increased expansion in this direction due to the excess of metal in the piston-pin bosses.

Several methods are being used for accomplishing this relief; some concerns turning the piston oval by the use of what is practically a relieving attachment, bringing the lathe tool in and out twice during each revolution. Others secure this relief with a milling cutter, which acts in a similar way to the relieving tool, except that it leaves a more or less abrupt shoulder at each end, tending to retain the oil in a pocket.

Still others grind this relief, either by bringing the grinding wheel in and out as the piston revolves or oscillating the piston back and forth in the same manner as with the milling cutter previously mentioned. One concern has devised a method of machining the sides of the piston in a punch press, this being in the nature of an outside broach which shaves the two sides at each stroke of the press. Can anyone give details of other methods?



Latest Practice in Cutter Grinding*—V

This installment, which is the last in the series on cutter grinding, describes modern methods used in grinding hand reamers for steel and also chucking reamers for cast iron, bronze, or steel, both roughing and finishing. The method of grinding taper reamers is also set forth.

IN GRINDING a hand reamer for steel, for the first setting we used a carborundum wheel shape No. 17, 6 in. in diameter, ½-in. face. For the second setting we used a cup wheel shape No. 2. The wheel should be dressed so that it will run perfectly true, and there should be no play in the spindle.

When grinding the cutting clearance, Fig. 43, since the land for this type of reamer is very small (0.006 in. to 0.008 in.), the cutting clearance is preferably produced by cylindrical grinding. The work is placed between centers, using the driving dog in the same way as for regular cylindrical grinding, and the knee is raised so that the work center and the grinding wheel spindle are in one plane. Special attention is called to the direction of rotation of the grinding wheel and of the work; the former counterclockwise, the latter clockwise, shown in Fig. 43.

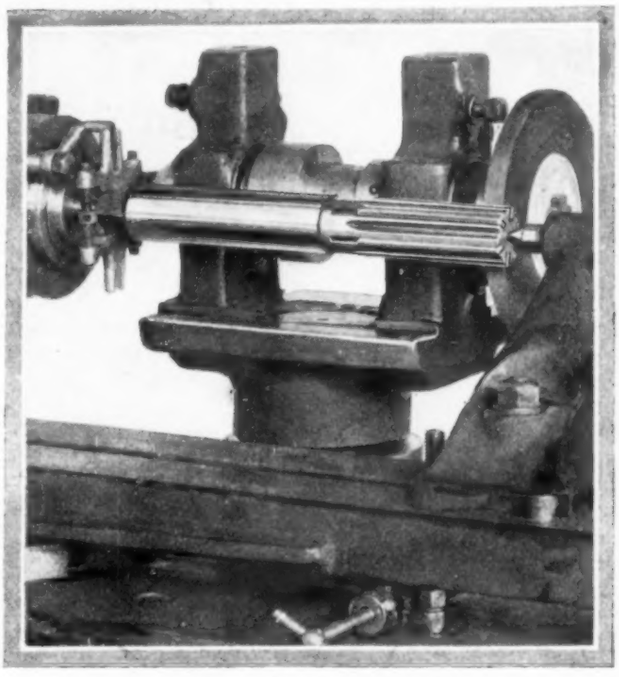


FIG. 43. GRINDING CUTTING CLEARANCE ON HAND REAMER FOR STEEL, BY CYLINDRICAL GRINDING METHOD

The heel of the blade strikes the grinding wheel first, resulting in more being ground off at this point than at the cutting edge. This produces a very small clearance, but it is sufficient in connection with the very narrow land required for reaming holes in steel.

Three operations are included in the first setting. First, the full length of the reamer is ground straight as just described. Next, the front taper is ground $\frac{3}{64}$ in. per foot, by swiveling the table, and next the back taper is ground $\frac{1}{4}$ in. per foot for a length of about $\frac{1}{4}$ in., by swiveling the table in the opposite direction.

The operations used in the second setting are the same as for backing off a hand reamer for cast iron, as was described in the previous issue, and consist of grinding the back taper part, swinging into the straight position and grinding the straight part, and finally swinging into position for the front taper and backing off this part of the blade.

It must be noted that in backing off these reamers, the land should be left not more than 0.006 in. to 0.008 in. wide. On very heavy reamers for large-diameter holes and when more than 0.002 in. of metal must be removed, the land should be left somewhat wider, and it may be advisable to use two reamers, roughing and finishing, for reaming large holes.

The front corner of the reamer is beveled in the same way as for the similar operation described in the previous issue.

As in hand reamers, the profile of a chucking reamer may be considered as divided into three parts: *A*, the front taper part, Fig. 44, which is made from $\frac{1}{2}$ in. to $\frac{3}{8}$ in. long, and with a taper of $\frac{1}{4}$ in. per foot; *B*, the straight cylindrical part, which is from $\frac{1}{4}$ to $\frac{3}{8}$ in. long, and the exact diameter of the hole to be reamed, and finally there is the back taper part *C* with a taper of $\frac{1}{4}$ in. per foot, and in length from $\frac{1}{2}$ to 1 times the diameter of the reamer. These dimensions are for a reamer that is to remove from 0.004 in. to 0.006 in. of metal.

Cup wheel shape No. 2 is used for all of these operations. The tooth rest is mounted on the grinding wheel head, the reamer is held against the tooth rest by hand, and the lever feed is used in grinding.

After setting up the machine, as described in the

*Copyright, 1919, by the Cincinnati Milling Machine Co. From a forthcoming treatise on cutter grinding.

previous issue, the following grinding operations are required for sharpening chucking reamers: In the first setting, grinding the cutting clearance, the full length of the reamer is ground straight, next the front

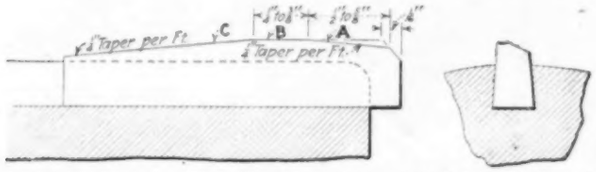


FIG. 44. PROFILE OF BLADE OF A CHUCKING REAMER FOR CAST IRON OR BRONZE

part is ground to a taper of $\frac{1}{4}$ in. per foot for a length of from $\frac{1}{8}$ in. to $\frac{3}{8}$ in., and finally, the back taper is ground $\frac{1}{4}$ in. per foot for a length that will leave the straight portion of the reamer only about $\frac{1}{4}$ in. to $\frac{3}{8}$ in. long.

Grinding the second clearance, which is done in the second setting, involves grinding the straight part and running back the full length of the back taper, then backing off the front taper part. The land should be left not more than 0.015 in. to 0.020 in. wide.

In good practice, two reamers are used for finishing holes in steel: a roughing reamer and a finishing reamer. The roughing reamer, which is usually a solid

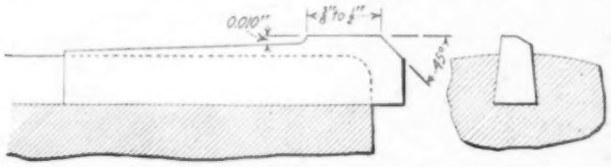


FIG. 45. PROFILE OF THE BLADE OF A CHUCKING REAMER FOR STEEL ROUGHING

reamer, has a profile as shown in Fig. 45. There is a straight part $\frac{3}{8}$ in. to $\frac{1}{2}$ in. long which is ground to the diameter to be rough reamed. This is generally about 0.002 in. below the diameter of the finished hole. Back of this part the reamer blade is made 0.020 in. smaller in diameter. The beveled corner in front does a good deal of work and should be given as much clearance as possible. The amount of metal to be removed by a roughing reamer may be as much as $\frac{1}{32}$ in. in the diameter of the hole. However, it should be borne in mind that the less metal there is to remove the better the finish and the more accurate the hole will be. These reamers as commercially manufactured are generally 0.004 in. over size. This amount must be taken off when the reamer is ground before putting it into

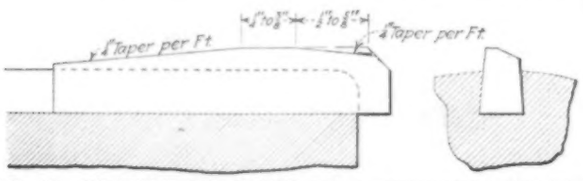


FIG. 46. PROFILE OF BLADE OF A CHUCKING REAMER FOR FINISHING STEEL

use. This is a cylindrical grinding operation the same as for a hand reamer as shown in Fig. 43.

For properly grinding roughing reamers of the solid type, the following operations are required: (a) The reamer is ground for second clearance on its full length, producing a land $\frac{1}{64}$ in. wide, using grinding wheel shape No. 2. The blades are ground straight their full length, there being no taper part on these reamers. (b) The reamer is ground for first or cutting clearance by cylindrical grinding. In this, the direction of rotation of both work and wheel on the setting is as for hand reamer for steel, Fig. 43. The wheel, striking the heel of the blade first, produces sufficient clearance. Grinding wheel shape No. 17 is used. (c) The diameter of the back end is reduced by cylindrical grinding to about 0.020 in. in diameter smaller than the diameter of the hole to be reamed. (d) The corner is ground to a 45-deg. angle with as much clearance as can be obtained, dropping the table 0.7 to 0.8 in. For this, No. 3 standard grinding wheel is used.

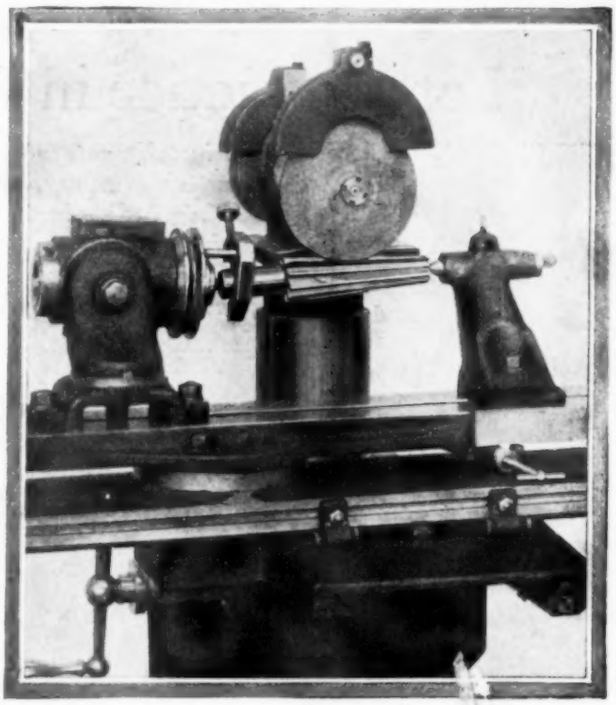


FIG. 48. GRINDING FACES OF TEETH OF A TAPER REAMER

The profile of a finishing, chucking, or machine reamer for holes in steel is shown in Fig. 46. It will be noticed that the profile of this reamer is the same as that of a chucking reamer sharpened for reaming holes in cast iron. The wheels must be dressed to run perfectly true, and there should be no end play in the spindle.

In the first setting for grinding the cutting clearance, wheel shape No. 17 is used. Since the land for this type of reamer is very small (0.006 in. to 0.008 in.), we recommended that the cutting clearance be produced by cylindrical grinding. Place the work between centers, using the driving dog in the same way as for regular cylindrical grinding, and raise the knee so that the work center and the grinding wheel spindle are in one plane. Special attention should be given to the direction of the grinding wheel and the work.

It will be noticed again in this case that the heel of the blade strikes the grinding wheel first, resulting in more metal being ground off at this point than at the cutting edge. This produces a sufficiently large clearance for steel.

The operations in the first setting are: (a) Grinding straight by this method the full length of the reamer; (b) grinding the front taper $\frac{1}{64}$ in. per foot by swiveling the table, and (c) grinding the back taper

| in. per foot for a lengtof about | in. by swiveling the table in the opposite rection.

For the second settinge operations are the same as for backing off a handeamer for cast iron, which was described in the preous issue. Grinding wheel shape No. 2 is used. In cking off this reamer, the land should be left not mc than 0.006 in. to 0.008 in. wide.

Grinding taper reamersequires the utmost care in order to maintain them solutely correct as to the angle of taper and the ameter. Therefore, there must be no shake or lost tion in any of the moving parts of the machine. Tl centers in the reamer itself should be in perfect alignment and should be lapped. For roughing reamers the tooth rest may be fastened to the table; for finishing reamers, however, it must be placed on the grinding wheel head, so as to produce a parallel and straight tooth. Aside from this, there is no difference in grinding, roughing, and finishing taper reamers, the former generally having fewer teeth than the ater (4 for roughing, 8 to 10 for finishing). When ginding taper reamers, as shown in Fig. 47, the operations are as follows: First the center of the work head i brought in line with the center of the grinding wheel ead. Then, after the dial on the elevating crank is set tzero, the table is dropped from 0.300 in. to 0.400 in. Th former is best for reaming hard material, the latter for soft material. Next, the tooth rest blade is set in lhe with the setting gage, after which the reamer is plaed between centers and the reamer tooth brought against the tooth rest blade. Finally, the cutting clearance is ground.

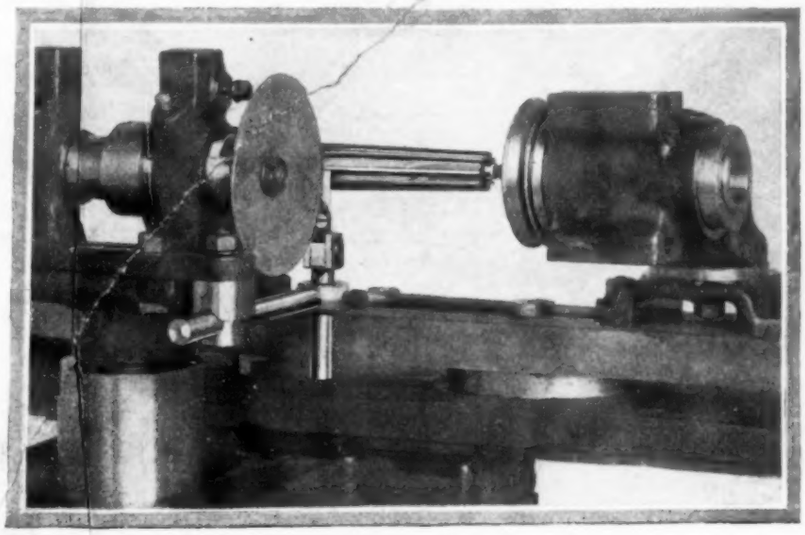


FIG. 47. GRINDING A TAPER REAMER

If the land is more than $\frac{1}{32}$ in. wide, it is too wide for either cast iron or steel, and the reamer should be backed off before it is ground for sharpening and cutting clearance. A trial collet should be used for gaging, and a trial cut should be taken with the ground reamer, and the reamed taper hole tested with a standard plug.

The cutting edge must be straight, and this is generally produced by oil stoning the faces of the teeth. If the faces of the teeth are too irregular to be straightened up with an oil stone they should be ground as shown in Fig. 48, using preferably grinding wheel No. 2, or if this is not possible on account of interference, wheel No. 3. The work head spindle should be depressed sufficiently to bring the bottom of the groove parallel with the top of the table, as shown in the illustration.

A very much improved hole and a larger number of reamed holes with one grinding of the reamer is often obtained by grinding a taper reamer slightly eccentric. One tooth of the reamer is marked, then ground off 0.0001 in., the next tooth 0.0002 in., the next 0.0003 in.

All of the foregoing also applies to sharpening reamers with spiral teeth. However, for spiral reamers the tooth rest must be mounted on the grinding wheel head, and the tooth rest blade adjusted to the angle of the spiral, the same as for spiral mills.

It is not an unusual thing for the toolroom of a large machine shop to be called upon for a small reamer, probably of special size, which is wanted immediately. The usual method of making such a reamer, putting it through the milling, hardening, and grinding operations, requires considerable time, causing delay on the production operation for which the reamer is required. It is possible to omit the milling operation entirely. The reamer blank is turned up the proper size and hardened, and the teeth are ground from the solid, using grinding wheel No. 5, which must first be trued up to the shape of the space between the reamer teeth. The lever feed is used and the work is adjusted vertically to the grinding wheel until the desired depth, as shown on the vertical adjustment dial, has been reached.

The indexing is done by means of the tooth rest used in combination with a notched collar attached to the rear end of the work head spindle. This method of making small chucking reamers has proved very satisfactory in our own shop. This same method will also be found very satisfactory for salvaging; that is, grinding out the tooth faces of small and medium size cutters which have become badly worn.

Broaching in a Shaping Machine

BY E. A. DIXIE

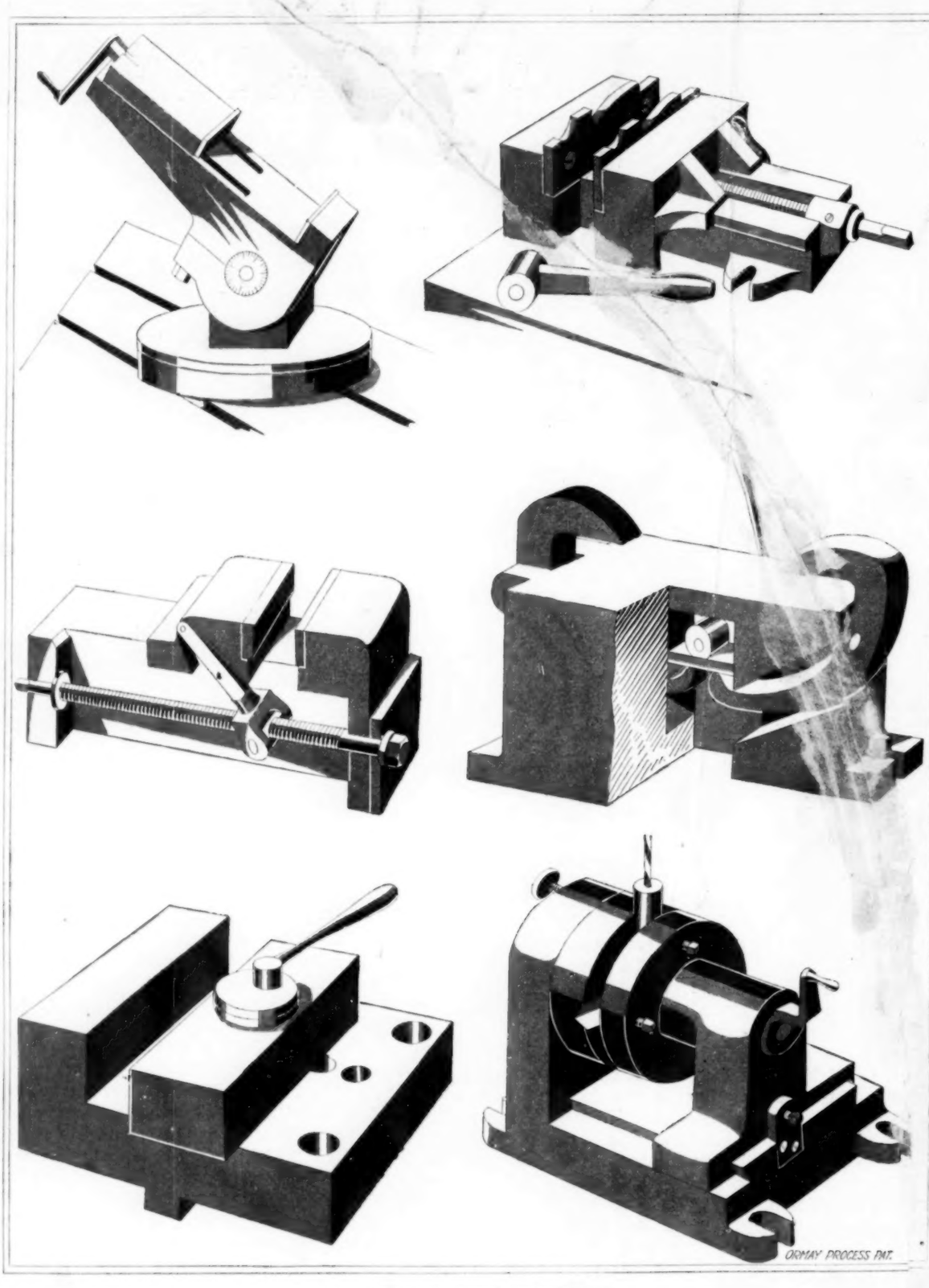
I would like a little more light on the shape of the broaches, one of which is shown on page 1201, Vol. 50.

The author mentions measurements to 0.0005 in. in two places in the article, and then goes on to say the "cutters were peened in." What is meant; were the cutters driven into the holes in the bar, or were they fitted in holes in the bar and the metal around the cutter "peened" to hold them in? Further on, he says: "The broaches were made of machine steel turned down 0.0005 in. smaller than the hole in the bracket." Either of the methods (mentioned in the paragraph above) for securing the cutters would spring and expand that bar so that it would not go into a hole only 0.0005 in. larger than its normal diameter when it was straight.

There is another element which puzzles me. What became of the chips? The broach as shown provides no chip space in front of the first cutter.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



VISES FOR SPECIAL PURPOSES

Operations on the British 9.2-In. Gun—II

BY I. WILLIAM CHUBB
European Editor *American Machinist*
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Ring, Wiring and Other Work

Among other things in this installment is a description of the manufacture of several sizes of rings from one forging by a combined process of trepanning, turning and boring. The whole scheme appears to be quite novel, though at present no figures are available with which to compare the cost of this method with that of the method in general use on such work.

A NUMBER of threaded and shrunk collars, like the one shown in Fig. 8, are taken from a single forging, the operations on which are as follows:

Operation 1.—Cut off surplus stock at the two ends to rough length.

Operation 2.—Lay out forging to diameters and bore.

Operation 3.—Rough-turn and prepare for boring.

Operation 4.—Rough-bore.

Operation 5.—Examine.

Operation 6. — Heat-treatment—About these operations little need be said: the lengths are bored and machined according to the type of collar, the ordinary boring tools, etc., being employed. The examination is for flaws.

Operation 7. — Trepan out test pieces—Four at least of these, $1\frac{3}{4}$-in. diameter by $5\frac{1}{2}$ in. to 6 in. deep, are taken from each end face, the ends being cut off to suit. Collars of each type must pass the same government tests. For the threaded collar the operations are as follows:

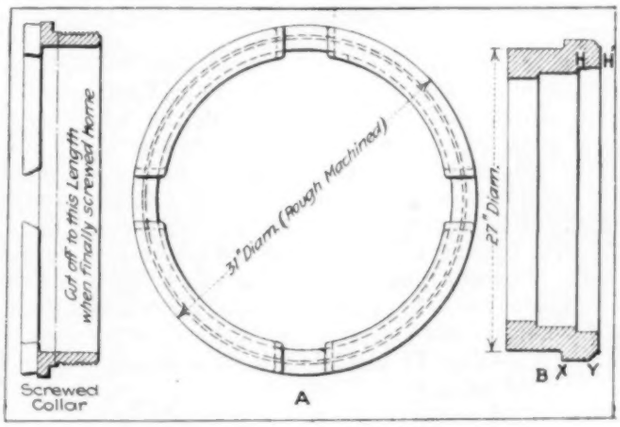

FIG. 8. THREADED AND SHRUNK COLLARS

Operation 1.—Cut off to rough length—The forging is marked off to the number of collars required and these are cut off and each has to be stamped separately by the government inspector.

Operation 2.—Finish-turn and thread outside and bore—For this either the lathe or a vertical boring mill may be employed. The outside and inside diameters are gaged, the latter to determine sizes to which to turn the gun.

Operation 3.—Plane slots—These are dovetailed and are used for screwing the collar home. On the shrunk collars there are but two main operations:

Operation 1.—Cut off to rough length.

Operation 2.—Rough- and finish-bore—A shrunk collar is shown at *B*, Fig. 8. The length from *H* to *H'* is not bored until the corresponding part on the A-tube is finish-turned, when allowance has to be made for shrinking, this being 0.025 in. Similarly, the exterior, marked *X* to *Y*, is not finish-turned until the corresponding length on the jacket has been finish-bored, the 0.02 in. allowed on this diameter being for the shrinkage. It is turned after the collar is shrunk on the tube. Inside and outside diameters are gaged as for the threaded collar.

One forging produces two sets of wire-securing and muzzling rings, there being on each gun six securing rings and one muzzle ring, which is really a wire-securing ring. The carbon-steel forging, Fig. 9, has the surplus stock cut off at each end to rough length; it is rough-turned and prepared for boring, and is then turned to $28\frac{1}{2}$ in. and bored to $12\frac{1}{2}$ in. and $17\frac{3}{4}$ in., and after examination by inspectors and heat-treatment, test pieces are sawed off the ends.

When the government tests have been passed it is usual first to trepan and cut off the end ring VII and similarly to produce the end ring IV. Next the two rings VII and IV remaining are obtained in the same way, which takes the piece to the end of first ring I, this being turned to diameter and cut off. The same follows on the other side, the rings being bored after the trepanning to suit the wiring. The wire-securing rings are finished 3 in. wide. In this way the 14 rings are obtained from a single forging. For turning and boring purposes the vertical boring mill is used. The rings, being light, would spring under pressure if chucked in the lathe, so before the rough pieces are cut off a flange is turned on each for clamping to the boring-mill table for holding purposes during the machining, this flange being cut off subsequently.

The inner A-Tube having been driven into the outer A-tube the following schedule of operations applies:

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Operation 1.—Test and spot — This is done in the lathe, the muzzle end being held by a chuck and the breech end supported by a three-point steadyrest with an additional rest in the center. Five spots are turned, one at the center of the tube, one at the part immediately over the position of the shot seat in the chamber, and one at the muzzle end, two extra spots being turned equidistant between the three.

Operation 2.—Finish-turn wire seat—The combined tube is held by a four-jaw chuck at the breech and at the other end by a cap center. In the latter the screws gripping the job must be strong to carry the load. The work is supported in a steadyrest about the center of the tube, and the turning, a dry operation, is done to a chart.

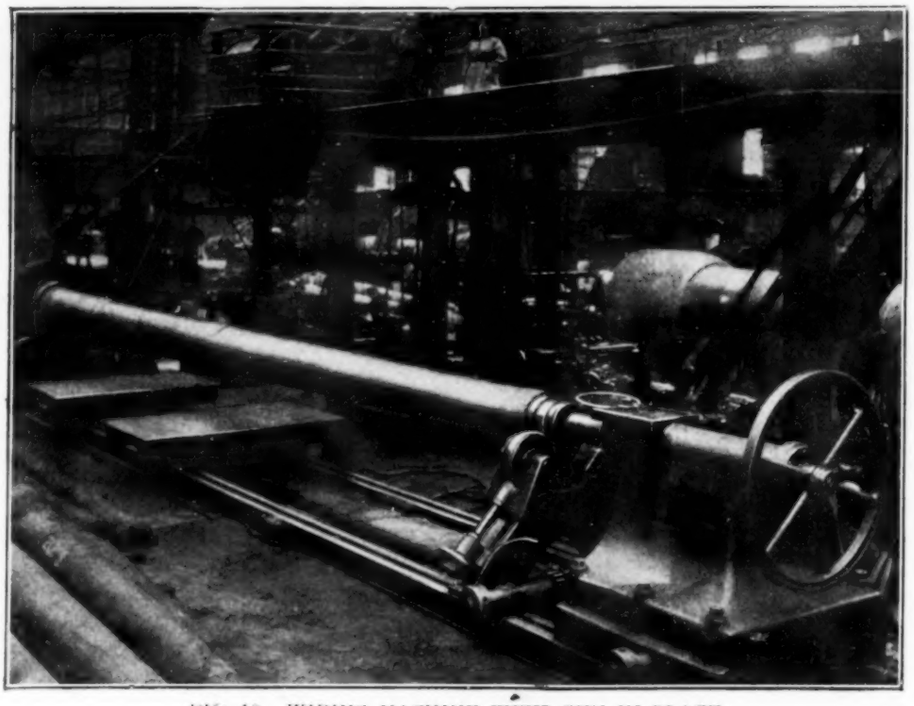

FIG. 10. WIRING MACHINE WITH GUN IN PLACE

Operation 3.—Turn shrunk collar seat and collar—This is also a lathe operation, but the combined tube is turned end for end, the step on the breech end of the gun being turned to suit the collar which is shrunk in position while in the lathe. The collar is heated to expansion gages by means of a gas ring slipped into position and allowed to cool. It is then turned on the outside diameter. It acts as a bearing afterward when rough-boring the chamber. The gun number is usually stamped on the end of the outer A-tube, part of the face being chipped out for numbering.

Operation 4.—Shrink muzzle ring—This is usually done in the wiring machine, the ring being heated by a gas ring and the temperature tested by the melting of a special solder and also by expansion gages.

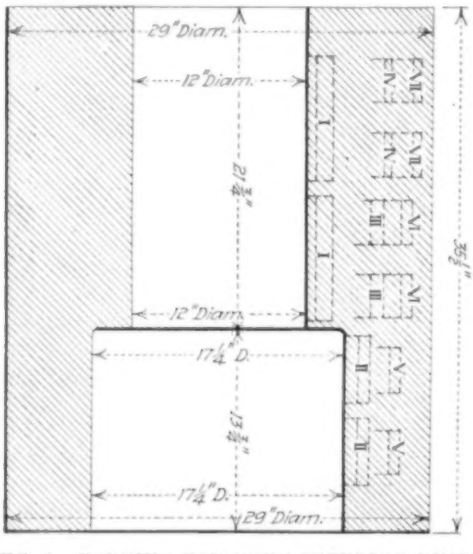

FIG. 9. FORGING FOR WIRE-SECURING RINGS

Operation 5.—Wiring—The wiring machine shown in Fig. 10 will coil wire on guns up to 57 ft. long, and it is driven by a 20-hp. variable-speed motor. The headstock has a fluid-pressed forged-steel spindle running in gun-metal bearings. The chuck has a ring at the back and is supported by rollers which take the weight off the spindle. Overhead is a carriage supported on girders, as shown, and actuated by a screw driven by an 8-hp. variable-speed reversing motor. The carriage has a cast-iron drum for the wire and also a brake drum essentially as described in connection with the 6-in. howitzer III.

The Brake and Paying-Off Drum

The arrangement of the brake and paying-off drum will be gathered readily from Fig. 11, in which *A* is the paying-off drum, *B* a guard for protecting the workmen in case the wire breaks, *C* a spring balance while *E* is a handwheel and screw for removing resistance from the brake drum *G*. *F* is a brake strap, *H* a winch for tightening the wire between machine and drum, *I* indicates the gun body in the driving machine and at *J* are hinged levers for taking the weight of the paying-off drum when changing from an empty to a full drum.

In this case the weight is taken on the levers by screwing up the setscrews when the collar *K* is removed and a piece of shaft screwed into that end of the drum shaft. The latter is withdrawn at *M* until one end of the lengthening piece reaches the center of the bearing *L*, the other being in the bearing *N*. The drum shaft is then unscrewed and withdrawn, the lengthening piece supporting the brake gear until the full drum is in place, when the shaft is returned to its original position. The brake strap is a sling of steel-wire rope, 0.75 in. in circumference, to which is fastened beech or elm blocks 5⅞ in. long, 2 in. wide and 1 in. thick, spaced

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about ½ in. apart by light staples. With this device wire may be run off the drum *A* on to the gun at about 150 ft. per minute.

The gun tube is held at one end in a four-jaw chuck and at the muzzle end by the tailstock center. The weight at this end is taken by screw-controlled rollers, the center being used merely to prevent lifting due to the pull of the wire in the operation and to hold up against the chuck. The wire section is 0.06 in. by 0.25 in., and about 7 tons 10 cwt. (say 16,800 lb.) is used on the gun.

The wire is supplied in 2-cwt. (224-lb.) coils, and two of these are wound on a small drum, the coils of wire being slipped on to a drum and then passed through rollers to the small drum which is rotated by a countershaft. Lengths are joined by splicing the ends and riveting together. The two-coil drum is then

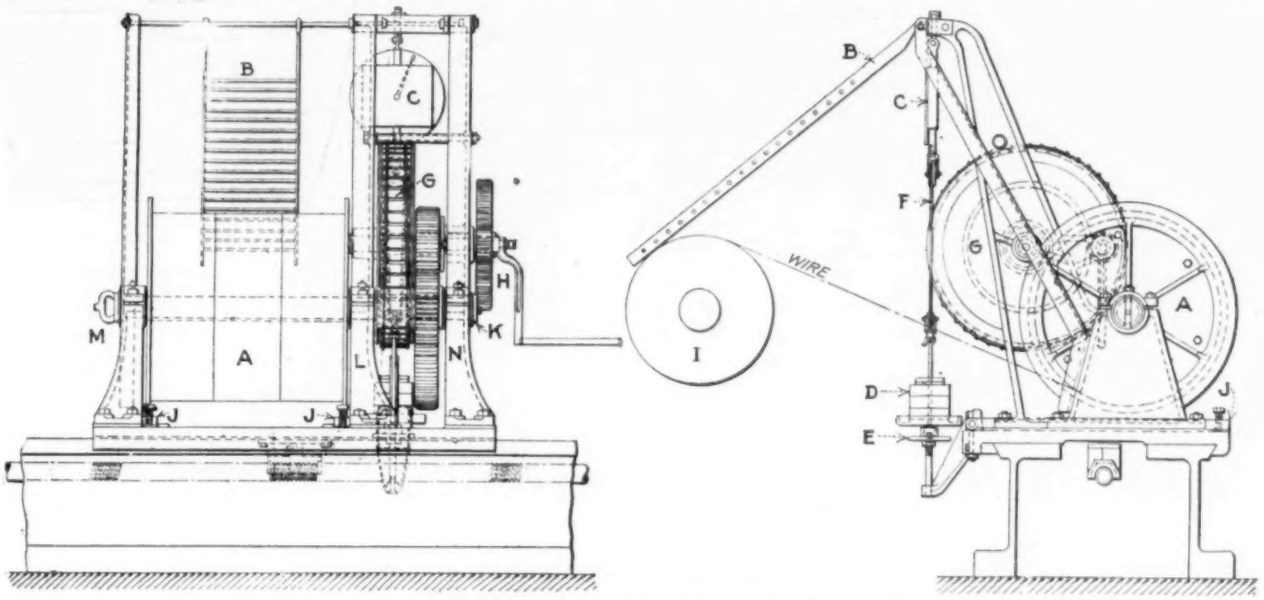

FIG. 11. DETAILS OF BRAKE AND PAYING-OFF DRUM

placed on top of the machine illustrated in Fig. 12, on a carriage which rolls longitudinally. The wire is brought down through tension rollers, as shown; the end is passed through a small hole in the large drum and this, when rotated by electric motor, draws the wire from the top drum, the clutch reversing when the end of the drum is reached, so that the wire is guided to and fro across the large drum, which finally carries 15 coils, or 30 cwt., of wire.

How the Wiring Is Done

In order to start the wiring a groove is chipped in the body of the A-tube, a small hole being first drilled and then chipped into so as not to leave a square corner. The end of the wire is then heated by blowpipe and upset, placed in the groove and riveted over. For the finishing end the bend is in the opposite direction, and this also is riveted.

During the wiring operation a number of wire-securing rings are shrunk into position. To do this the tailstock center is removed and each ring slipped over the tube and heated by gas till it melts solder. The solder used here is, by weight, 2 parts tin and 3 parts lead, the fusing point being approximately 400 deg. F. Cooling is accelerated by pouring water on the ring.

As has been stated, including the muzzle ring the tube has seven wire-securing rings shrunk on it and the wires are built against these rings as well as against the gun shoulder.

Preparing the Wire-Securing Rings

In preparing the wire-securing rings it is usual to measure the diameter over the wire when within about four layers from the finish-winding and then bore the ring to suit, making allowance for the layers that have to go on the gun. This is done to prevent delay at the wiring machine. In order to secure the wires small holes about $\frac{1}{10}$ in. are drilled in the section of the ring and then cut out with a small chisel so as to admit the wire, one end of which is pushed in and secured by a $\frac{5}{8}$-in. screw. The screw holes have to be drilled at different angles, as in some cases the wire dips and in other cases it rises. A typical ring with wire fastenings is shown in Fig. 13. Rings bent up of steel wire 0.25 in. by 0.06 in. in section fill in the corners on the steps of the gun and raise the wire to the next layer.

Gage Wiring

Operation 6.—Gage wiring—This is an inspector's operation done at 8-in. intervals along the tube for determining the B-tube and jacket sizes.

Operation 7.—Rough-bore the chamber—An ordinary long tool is held in the lathe carriage and the chamber is bored to within ¼ in. of finished diameters, but 1 in. is allowed on the length, as boring by the bar in this way is not specially accurate.

Operation 8.—Turn B-tube seat—The job is held in the lathe by a chuck at the breech end and a cap center at the muzzle end, with steadyrest at No. 3 ring. In this operation the ring (No. 3) nearest the breech end of the B-tube acts as a bearing in turning the wire.

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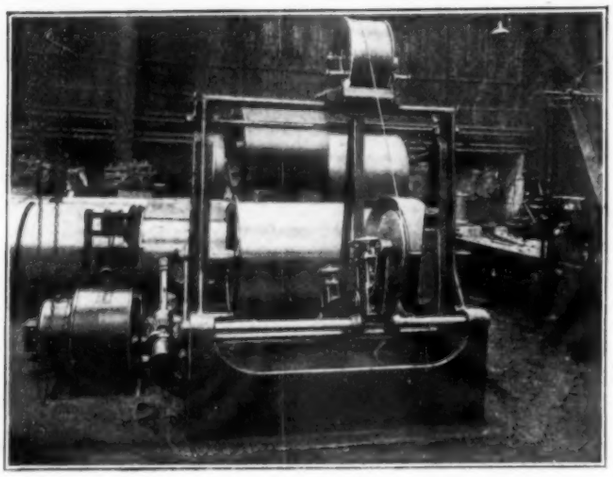

FIG. 12. COILING WIRE ON THE PAYING-OFF DRUM

The length is taken from the breech end of the gun for the breech face of the B-tube, lengths for the B-tube shoulders being taken from the face of the No. 3 wire-securing ring.

Operation 9.—Shrink on B-tube—This occurs at the gun pit.

Operation 10.—Turn jacket seating—The work is done in the lathe, turning on the B-tube and wire to suit the jacket.

Operation 11.—Build tube—This again is a gun-pit operation, from which results the built-up gun. Before it is done it is usual to reduce part of the shrunk collar at the breech end to within 0.10 in. of the threaded-collar size, the job being held in the lathe chuck and supported by a plug center in the bushing seat.

Operation 12.—Test and spot and rough-turn—Held by the four-jaw chuck in the lathe and supported by the three-point steadyrest the bore is set true and tested by the rocking bar and then a bearing is turned at about the center of the gun true to the bore, the material being just trued up. Using this for a steadyrest the body is rough-turned to within 0.10 inch.

Operation 13.—Reamer-bore to finished size—This operation is essentially the same as the third finish-boring cut taken on the inner A-tube before it was driven into position. The work is done in a horizontal boring machine and it is usual to finish it in two cuts, the first taking the hole to within 0.015 in. and the second to size. All reaming cuts are stopped when half way through, the tools withdrawn and examined and the bore gaged. If the bore is more than 0.005 in. under size it is necessary to start the cut again, and if the bore is finally found to be 0.005 in. below the limit the gun is lapped. This however, is exceptional. The reaming head has five cutting tools adjusted for

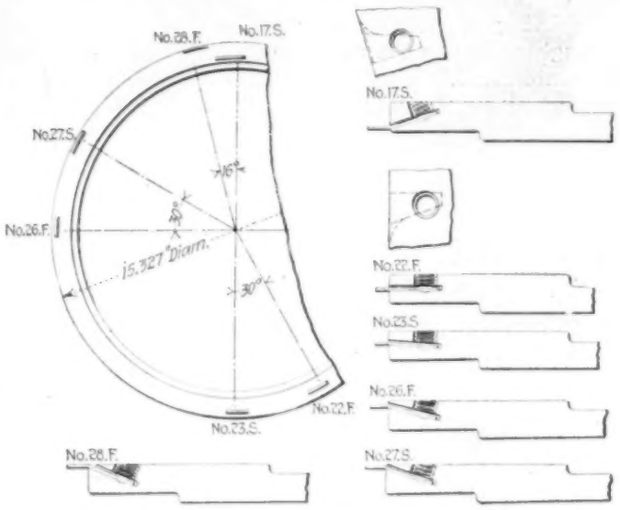

FIG. 13. WIRE-SECURING RINGS

height by screws. A cast-iron leader placed in front of the head is dragged through the hole first in order to make sure that it clears the bore. The actual diameter of the leader therefore is say 9.19 in., but it depends on the size of the previous bore. Of the five bearing strips on the boring head three are of lignum-vitæ, while two, to take the weight, are of hard brass. Two about 6 in. long by 1½ in. wide are placed 10 ft. apart on the boring bar.

Operation 14.—Finish-bore chamber—The chamber is

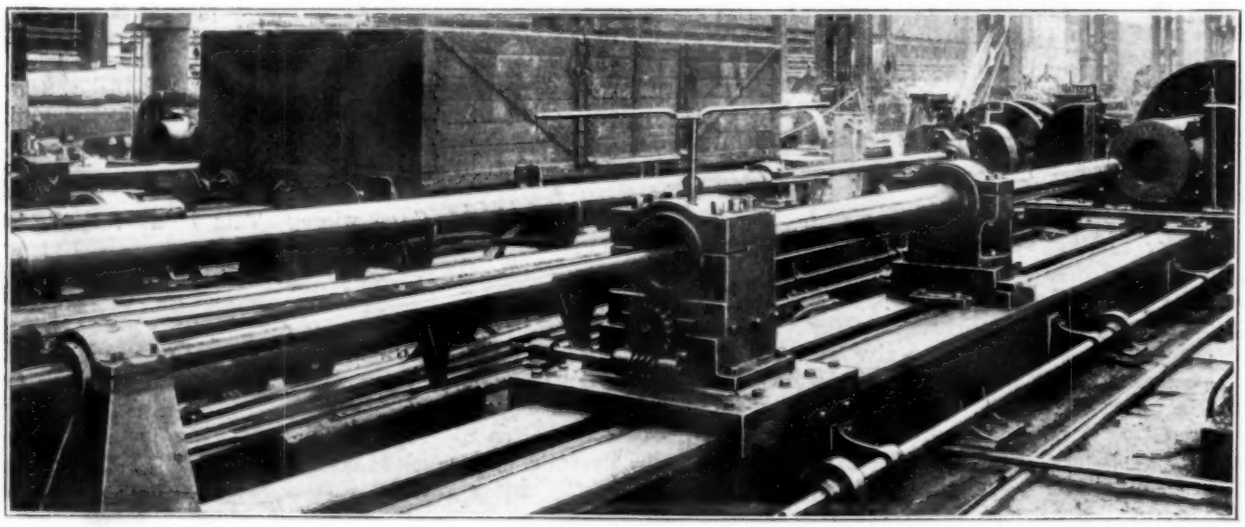

FIG. 15. THE BAR IN BORING POSITION IN THE LATHE

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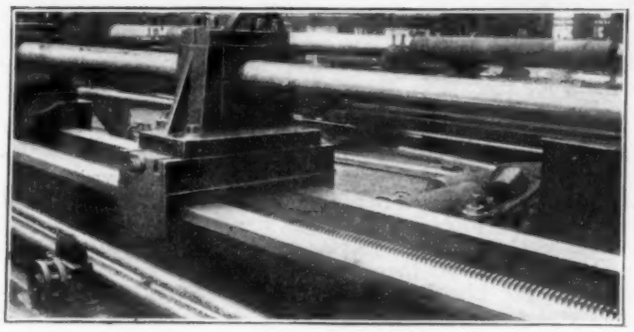


FIG. 14. THE BAR AND THE CUTTERS

tapered at both ends, so a special hollow bar is used for boring it. Views of the bar on the boring machine are given in Figs. 14 and 15. Inside the bar is a copy bar with inclined slot, Fig. 16, by means of which the amount of taper is determined. The link, as the copy bar is called in the shops, has bearings at each end and is controlled by rack and pinion, the rack being controlled by a screw on the end. The links employed vary with the tapers desired. The chambering bar is supported in a standard, but inside the gun it is carried by a spring bushing of gun metal 9½ in. wide, split and turned to the taper of the bore. Inside this is a cast-iron bushing driven in and bored to the size of the chambering bar. The cutting tools vary according to the form of chamber. The first part finished in the chamber is the front taper. In this operation it is necessary to make sure that the over-all length of the chamber is correct. The link is then changed for the rear portion, finishing the rear taper and the large diameter.

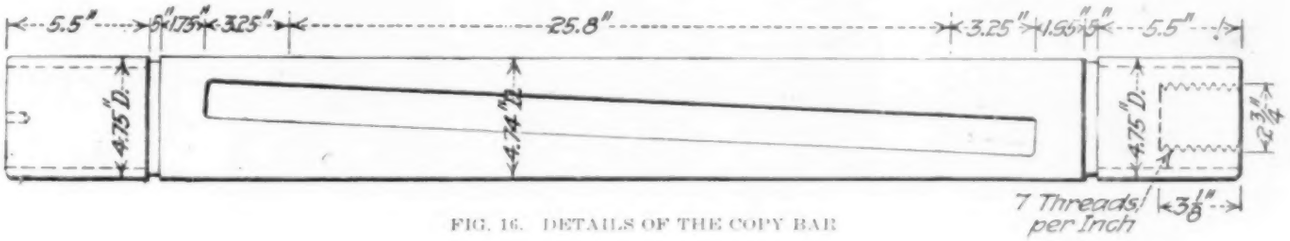


FIG. 16. DETAILS OF THE COPY BAR

Operation 15.—Finish threaded-collar seat and put on collar—This operation usually forms part of operation 12.

Testing for Truth of Bore

Operation 16.—Finish body of gun at breech end—Placed in the lathe and secured by the muzzle end in the chuck the gun is tested for truth of bore and is spot-turned at the breech and muzzle ends and in the center for steadyrests. It is then turned to gages for diameters and shoulders, an ordinary turning job, though certain diameters specified have limits of 0.005 in. at the breech end where parts fit on, the same limit applying between widths on collars, etc.

Operation 17.—Thread breech-bushing seat and build breech bushing—Before starting the thread the high side, if any, in the bore is determined, and this made the bottom of the gun, so that when it sets in the cradle the bore will adjust itself.

Operation 18.—Finish breech face—This is to drawing dimensions, measuring from the face of the inner A-tube.

Operation 19.—Finish-turn muzzle end—The gun is turned end for end in the lathe and run in a steadyrest, being held by a chuck at the other end. The muzzle end is finished and the radius turned to a templet, the whole being a simple turning job.

PERSONALS

Capt. Bainbridge Cowell, who has been on duty in the Nitrate Division, has left the service. He is a graduate of Yale and before being commissioned was treasurer and general manager of the Roy Cliff Marble Co., Cleveland, Ohio.

* * *

First Lieut. P. H. Taylor, who is an electrical engineer and a graduate of Lafayette College, has been discharged from service. His home is at South Germantown, Penn. He has been on duty at the Aberdeen Proving Ground as a proof officer.

* * *

Maj. James J. Humphreys, who was commissioned Captain in August, 1917, has been discharged. Major Humphreys' permanent address is the Montreal (Canada) Light and Power Co. He has been on duty in the Boston District Office and in civil life was engaged in the management of illuminating gas companies.

* * *

Capt. William L. Libby, who was appointed First Lieutenant in September, 1917, has been discharged. His duties have been with the Artillery Ammunition and Metal Components Division. In civil life he is a mechanical engineer and was employed by the International Machine Tool Co. His permanent address is 2604 College Ave., Indianapolis, Ind.

* * *

Capt. Eugene A. Main, who was commissioned in December, 1917, and whose work has had to do with cost-plus contracts, has been discharged. His home address is 215—84th St., Brooklyn, N. Y. He was formerly employed by E. W. Bliss of that city in the design and sale of sheet-metal machinery. Captain Main is a graduate of Cornell.

* * *

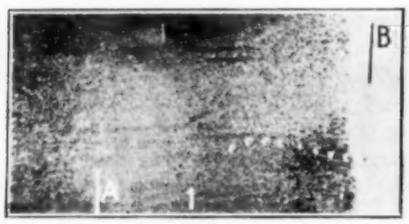
Capt. Philip H. Glatfelter, who was appointed First Lieutenant in September, 1917, was discharged recently on his return from France. Captain Glatfelter was on duty with the 3rd H. M. O. R. S. St. Sulpice, France. He is to be general manager of P. H. Glatfelter Co., Spring Grove, Pennsylvania, where he lives.

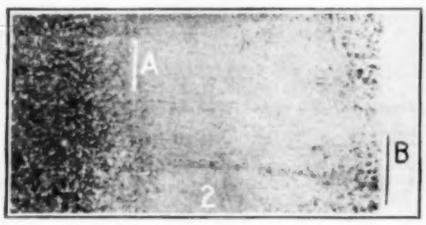
Fusion Welding as Applied to Drop-Forging*

By S. W. MILLER
Rochester Welding Works, Rochester, N. Y.

Consideration is given in this article to both the electric-arc and the oxy-acetylene processes for the repair of defective drop-forgings by the method of fusion welding of the defective sections. A number of micro-photographs are shown for illustrating the physical effects that may occur in the weld and in the adjoining sections of metal due to the heat developed and the methods of application of the processes.

THERE are a number of questions in connection with the application of fusion-welding processes to drop-forgings, which have to be considered before a decision can be made as to their use. The principal ones are as follows: First, can fusion welding processes be applied; second, if so, what process should be selected; third, will a forging reclaimed by welding be satisfactory to the customer; fourth, will a welded forging give as good results as one not requiring welding; fifth, will the cost of welding be greater than that of a new forging? It would appear clear that the answers to some of these questions are not within my province, as I cannot decide, for instance, whether a welded piece, no matter how good the job, would satisfy the customer, nor can I decide as to the relative costs of welding pieces and new forgings. What I propose to do, therefore, is to present my ideas as to the possibilities of producing certain results by welding and leave the application of these ideas to you.





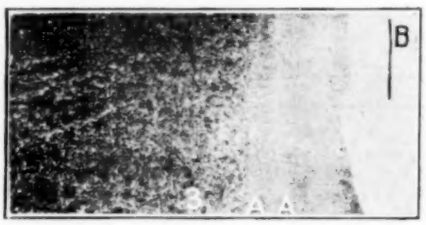


Fig. 1. Oxy-acetylene weld in 0.50 per cent. carbon shell steel using 0.15 per cent. carbon wire. Magnified three diameters.
Fig. 2. Oxy-acetylene weld in 0.50 per cent. carbon shell steel using 0.60 per cent. carbon wire. Magnified three diameters.
Fig. 3. Electric weld in 0.50 per cent. carbon shell steel with 0.15 per cent. carbon wire. Magnified 3¼ diameters.

Two Methods

There are two methods of fusion welding which are applicable to the repair of drop-forgings, and each has its peculiarities, limitations, and advantages; that is, the oxy-acetylene and the metallic-electrode arc. The melting temperature is maintained in the former case by the combustion of acetylene in the presence of oxygen; and, in the second, the melting temperature is obtained by using the electric arc drawn between metal electrode and piece to be welded.

I believe it will be generally found that the oxy-acetylene process is more applicable to the reclaiming of drop-forgings than the electric, especially where the defects are small; because, while the electric process is considerably cheaper, the cost of operation being only about half that of the oxy-acetylene, there is greater liability with the electric process of not getting thorough fusion at the beginning of the work. In other words, as the arc is drawn between a rather heavy mass and the electrode, the former requiring some time before the forging is brought to the fusion point and the beginning of the weld is liable to be imperfect. With the oxy-acetylene method, the piece can be brought to the melting point before any metal is added, thus insuring thorough fusion. These points should be considered in deciding which process should be used. There remains for discussion, therefore, only the fourth question, which refers to the quality of the weld itself and the effect of welding on a forging. The more important of these is the quality of the weld.

To begin with, it should be understood that the writer is not advocating, and has never advocated, the indiscriminate use of welding processes. His belief is that for many purposes a welded piece is just as good as a solid piece but he also believes that there are many cases where a welded piece will not give satisfactory results, and in such cases he advocates very strongly that the pieces be scrapped. The reason for this lies in the nature of welds. A fusion weld is a casting and no matter by what process it is made, how good it is, or to what heat-treatment it is subjected, it cannot have all the qualities of a forging, so that at a point where a heat-treated casting will not give good and safe results, a welding process should not be used.

In order to make clear the effects of welding, it should be remembered that the heat of the welding flame or arc is very high and there is a strong tendency to burn out, both from the welded piece and the weld itself, such elements as carbon, manganese, and silicon so that the weld is usually of very different composition chemically from both the original material and the welding rod.

The effect of the heat on the material being welded is different also in the two processes. With the oxy-acetylene method, the temperature is not so high nor is it so local, the result being that the heat effect extends a greater distance from the weld, as shown in the micro-photographs Figs. 1 and 2; and, as the heat has to be applied longer, the coarsening of the grain near the weld is greater than with the electric method, Figs. 3 and 4. The Ac_3 points are shown at *A* by changes of color upon etching and the lines *B* show the location of the original surfaces, below which points the decarbonization of the metal will be noted. The loss of carbon is greatest in the electric weld and least in the oxy-acetylene weld made with 0.06 per cent. carbon wire.

The quality of the material being welded should also be considered. If it is plain carbon steel, the higher the carbon content, the greater the injury by welding to its physical characteristics. The writer's experience leads him to believe that material up to about 0.50 per cent. carbon can be satisfactorily welded provided it is properly heat-treated to remove the grain coarsening. By this he means that there is no permanent damage to the material. He does not mean, necessarily, that the welded piece will be satisfactory, even if the weld be sound.

Quality

Three things have to be considered in deciding the quality of a welded piece; first, the effect on the piece itself; second, whether the weld will be sufficiently strong and otherwise suitable; third, whether heat-treatment can be applied to improve the qualities of the welded piece and the weld. The answers to these questions evidently depend on the results desired.

If heat-treatment is to be applied, some consideration should be given to its effect on the welded piece and the

*Abstract of a paper written for the Annual Convention of the American Drop-Forge Association at Pittsburgh, Penn., June 12, 13 and 14, 1919.

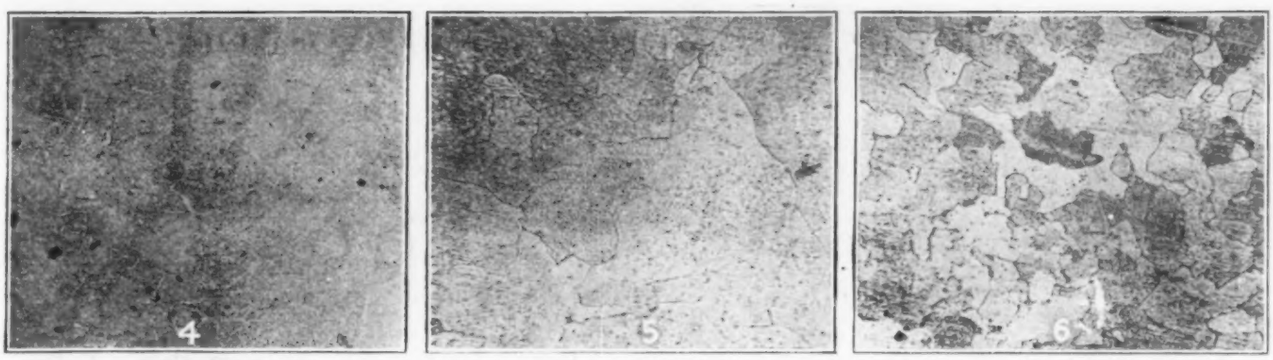


Fig. 4. View on line of electric weld with weld at right. Showing the original material coarsened by heat. Magnified 50 diameters. Fig. 5. Showing very coarse grain in oxy-acetylene weld. Magnified 200 diameters. Fig. 6. Same weld as in Fig. 5 after heating to 1800 deg. F. for 10 min. The weld material is refined but the temperature is slightly high for the best results. Magnified 200 diameters.

weld. In an examination of the effect of such treatment on oxy-acetylene welds made in material containing about 0.18 per cent. carbon, the writer found that there was a difference of about 300 deg. F. between the refining temperatures of the material and the weld, the latter being made with wire of the composition referred to above. This is accounted for by the difference in carbon content and also by the fact that the weld is a casting which in order to obtain the best results requires a higher refining temperature than a forging of the same carbon content. Therefore, when welding material of this kind is used, a double heat-treatment is necessary, a high temperature, about 1700 deg. F., for refining the weld, and a lower one, about 1450 deg. F., for refining the original material, Figs. 5, 6, 7 and 8. It would seem advisable from this to provide a welding material which would require the same refining temperature, and which would have the same physical characteristics, as nearly as possible, as the material being welded. The possibility of this is a question. It would appear possible to increase the carbon in the welding wire so that in the weld there will be the same carbon content as in the piece, but another difficulty is introduced, which is a practical one. Such welding material is difficult to handle and unless extreme care is used, the weld will be more dangerous than one made with low-carbon material.

As illustrating the effect of heat-treatment, the reader may refer ahead to the part of the weld, shown in Figs. 10 to 14 inclusive, which was heated to 1550 deg. F., quenched in oil, drawn at 800 deg. F., and cooled in air. The structure of the weld is shown in Fig. 10, while the structure in the original material is shown in Fig. 11. The weld, of course, contains less carbon than the material welded so that more ferrite is shown in the weld, but it is easily conceivable that for certain purposes such a weld would be entirely satisfactory. This is an illustration of the line of investigation including chemical and physical tests that must be followed in order to determine whether welding in any particular case may be permitted.

Electric Welds

With regard to electric welds, the writer has not yet found it possible to improve their elongation by any method of heat-treatment, Figs. 15, 16, 17 and 18. The large amount of nitride of iron present in such welds does not seem to affect their strength, Fig. 19, because they rupture along the grain boundaries. The writer believes that such intergranular brittleness is due to ultra-microscopic films of oxide of iron and is not aware of any way of eliminating these at the present time. Fig. 20 shows how electric-weld material would distort if free from such films. It also does not seem to make any difference what material is used for electrodes. This problem will undoubtedly be solved, but it will take time and patient investigation.

Electric welds are also subject to defects such as shown in Figs. 21 and 22, but clean electrodes and careful welding help to eliminate them.

The question of cost enters to a very large extent in all this work. It might pay to repair drop-forged automobile axles by any welding process because of the expense of the forging, while it certainly would not pay to repair a small part. Also the results in the case of the axle would be entirely satisfactory, where, for example, a corner of one of the spring pads did not fill out in the die as there is a surplus of strength at this point. Axles broken in the middle by collisions have been welded and many other repairs have been made which are considered perfectly safe and which have never given any trouble in service.

In making electric welds, the conditions are such that it is difficult to get them free from films of oxide, slag pockets, etc. It must be remembered that everything in the electrode goes into the weld, and if the electrode is imperfect and contains slag and dirt, the weld will also

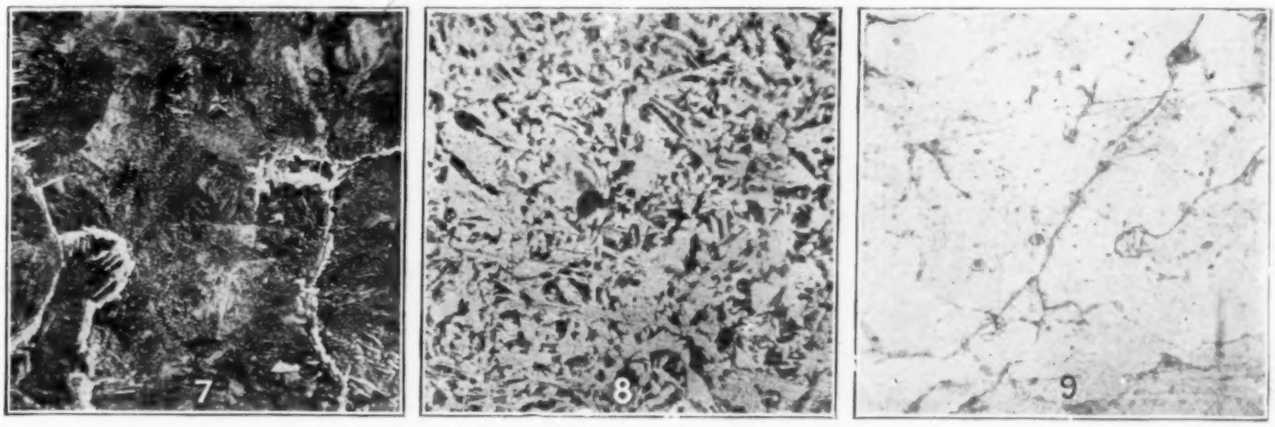


Fig. 7. Original material of oxy-acetylene weld shown in Fig. 5. This has been heated 1800 deg. F. for 10 min. to refine the weld and this has greatly coarsened the grain. Magnified 200 diameters. Fig. 8. Same weld as in Fig. 7 after reheating. This material has been reheated to 1400 deg. F. for 15 min. for refining. Magnified 200 diameters. Fig. 9. Visible oxide films in oxy-acetylene weld made with 0.40 per cent. carbon wire. These films occur with other welding wire, but are not so hard to avoid. Magnified 200 diameters.

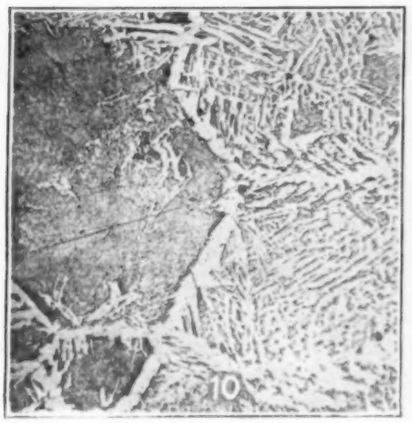


Fig. 10. View in oxy-acetylene weld showing column primary grains and showing also the manner in which the grains are coarsened next to the weld on the left. Magnified 200 diameters. Fig. 11. Very coarse grains found next to the weld. Same weld as shown in Fig. 10. Magnified 200 diameters. Fig. 12. Great refinement of grain crystals found $\frac{3}{8}$ in. from weld. Same weld as shown in Fig. 10. This is the point at which the Ac_3 temperature has occurred. Magnified 200 diameters.

contain these same impurities. Furthermore, the tremendous oxidation of the iron as it passes through the arc is detrimental to the quality of the weld. This does not mean that this method of welding is not suitable for many purposes, because it is suitable and has been successfully used. For such purposes as filling up holes that have been drilled wrong, for filling up worn key seats, for replacing metal where too much has been removed in machining, its use is entirely satisfactory.

The advantages of the electric weld are its low cost and the speed with which it can be made. Its principal disadvantage, brittleness, has been referred to before. And if there is enough work to warrant the installation of an electric welding outfit, its use will be found economical. One matter which should be watched closely in connection with electric welding is the effect of the high temperature and its sudden application to steels containing about 0.40 per cent. carbon. It has been found in such steels, particularly where the piece welded is of considerable size, that the quenching effect of the cold metal produces a zone of sorbitic character next the weld, which may start a detail fracture under alternating stresses. The work referred to is of the nature of adding material to worn shafts in order to build them up to the proper size. While the welding is successful, the alteration of the structure is dangerous. This difficulty can be readily overcome by preheating the shafts to a high enough temperature to prevent the formation of the brittle zone. This temperature would depend on the size of the shaft, being less for a large shaft than for a small one. The slow cooling, due to the preheating, prevents the formation of sorbite and no trouble is experienced. With oxy-acetylene welding, however, this defect does not exist, as the piece being welded must be brought to a high temperature before any welding is done and this is sufficient to anneal the material near the weld.

Testing the Welder's Ability

It may be of interest to know the writer's experience in the quickest and easiest way of determining a welder's ability. This is to have him weld together two pieces of $\frac{1}{2}$ x 2-in. ordinary bar steel in the case of gas welding, or two pieces of $\frac{1}{2}$ x 3-in. bar steel in the case of electric welding. The reason for using the wider piece in electric welding is that both the beginning and end of an electric weld are liable to be bad for $\frac{1}{2}$ in. from the edges. This is because the temperature has not been raised to the proper point and the end is bad because the temperature is too high. With oxy-acetylene welding the temperatures at the beginning and end can be regulated by the operator. The electric weld should be machined off for $\frac{1}{2}$ in. on each side, leaving the piece about 2 in. wide. If such pieces are then clamped on an anvil or heavy block, so that the bottom of the V is on a line with the face of the anvil and the projecting part of the piece is struck with a sledge, a very good and rapid test can be made of the welder's ability and the quality of the weld.

It will be found that electric welds are very brittle and will not stand much bending, while gas welds if properly made will bend down flat and will even stand further bending before cracking on the outside of the weld. An examination of the fracture will indicate the mechanical soundness of the weld. Beyond this the welder cannot go as he has but little to do with the metallurgical character of the weld.

In the oxy-acetylene welds made with ordinary material the weld is coarse grained, and on account of the distribu-

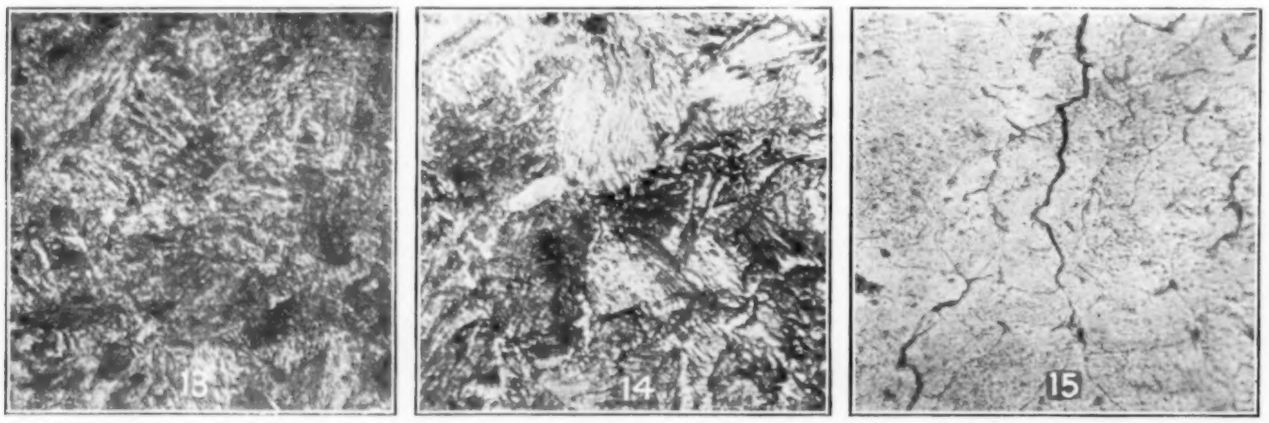


Fig. 13. Weld after heat-treatment showing martensitic structure. This has been heated to 1525 deg. F., quenched in oil, drawn to 800 deg. F. and air cooled. Magnified 1200 diameters. Fig. 14. Same weld after heat-treatment showing Pearlite and Ferrite structure. This has been heated to 1550 deg. F., quenched in oil, drawn to 800 deg. F., and air cooled. View in the weld shows more pearlite and ferrite than the original, and less carbon. Magnified 1200 diameters. Fig. 15. An electric weld after straining showing rupture at grain boundaries. No defects were visible in this weld before rupture. Magnified 430 diameters.

Fig. 16. Structure of an electric weld after heat-treatment. This material, heated to 1800 deg. F. for one hour and quenched in ice water, shows usual structure with spots of iron nitride in ferrite matrix. Magnified 430 diameters. Fig. 17. Same weld shown in Fig. 16 after straining to rupture. The ruptures are along grain boundaries and at small defects. Magnified 430 diameters. Fig. 18. An electric weld normalized, showing the ruptures are still intergranular. Magnified 430 diameters.

tion of the heat, the grains are approximately equi-axed. Most of the carbon has been burned out by the heat so that what is left exists as isolated particles of cementite at the grain boundaries. There is also present more or less oxide, which is readily seen in an unetched section as small, round, what is probably nitride of iron, due to the combining of the nitrogen of the air with some of the iron, Fig. 25. Between the body of the weld and the original material, there is a zone of gradually changing carbon content, as would be naturally expected. In this zone, unless proper fusion

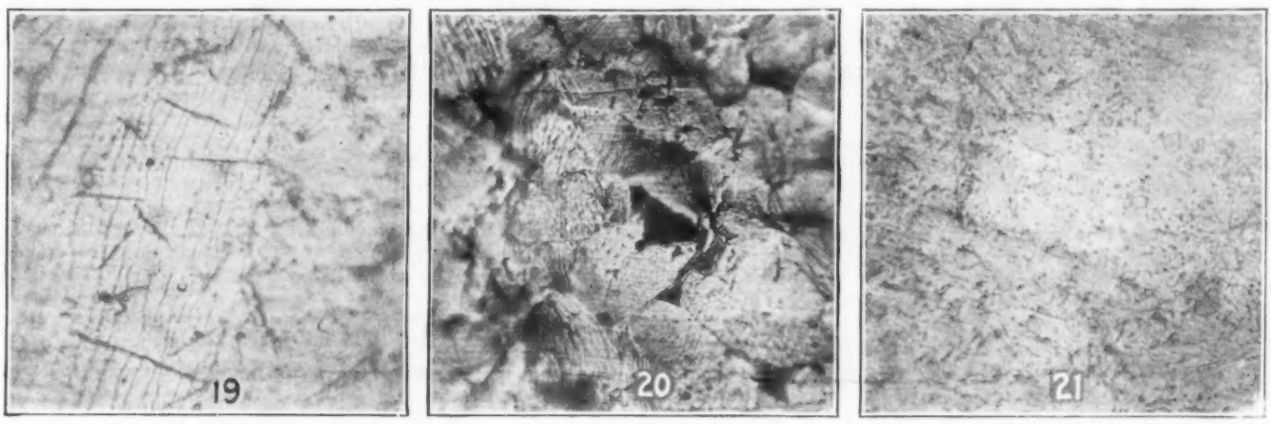


Fig. 19. Electric weld showing slip bands bear no relation to iron nitride plates. Magnified 1200 diameters. Fig. 20. A small spot free from intergranular ruptures in heavily strained electric weld. The surface has been normalized. The dark spot in the center is iron-iron nitride eutectoid, which has no effect on strength, as all grains distort by slipping. Magnified 430 diameters. Fig. 21. Electric weld iron globule coated with oxide film. A very common defect. Magnified 430 diameters.

dark dots, Figs. 23 and 24. There are frequently minute holes, probably caused by the escape of occluded gases during cooling. Especially in the tops of welds made with a heavier tip than necessary there are plates and needles of has occurred, there are liable to be films of oxide of great thinness, which are not visible in the polished section, but which etching shows up distinctly. These films are of the order of 0.00002 in. thick, Fig. 9, and have the effect of

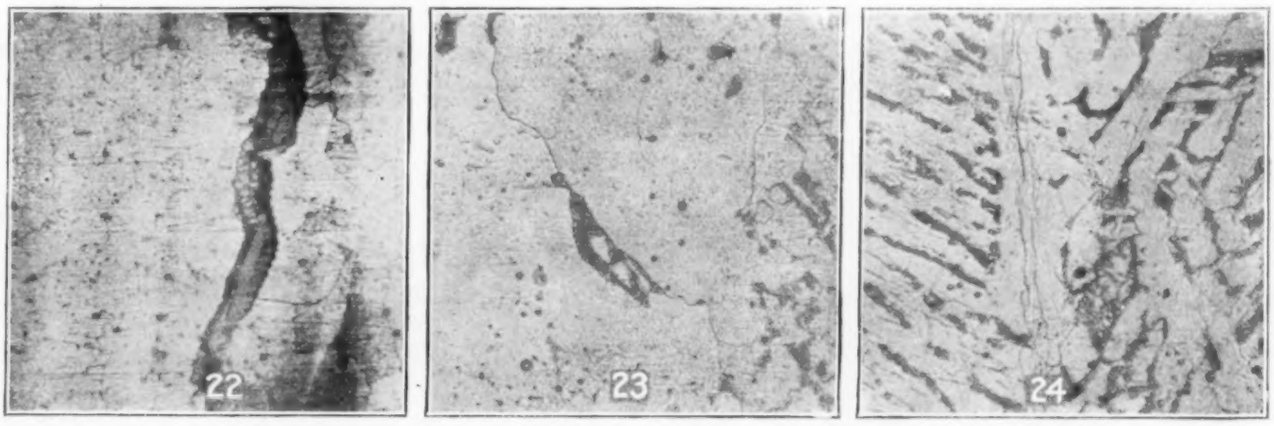


Fig. 22. Strained electric weld ruptured along a streak of slag. Magnified 430 diameters. Fig. 23. Grain boundary rupture in oxy-acetylene weld before straining. Made with 0.40 carbon steel wire. Nothing visible before straining except usual grain boundaries. Oxide shows as small round dots. Magnified 430 diameters. Fig. 24. View of weld after straining, showing primary and secondary grain boundaries. Same weld as shown in Fig. 23. Shows the secondary pearlite and ferrite grains, with the rupture along the primary grain boundaries. The primary grains are equi-axed, but the secondary grains are columnar. Oxide shows as small round dark spots. Magnified 430 diameters.

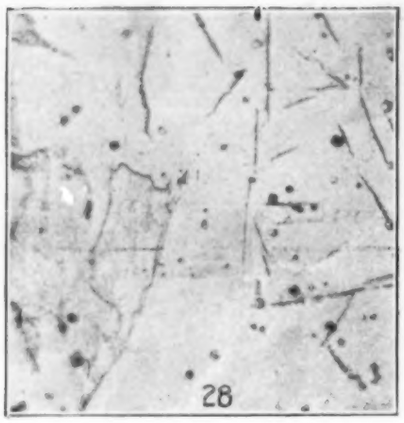


Fig. 28. Same weld as Fig. 27 with greater magnification. Shows iron-iron nitride at the right. Magnified 1200 diameters. Fig. 29. Electric weld showing iron nitride which may contain some iron carbide. This weld is in the normalized condition and has been etched with nitric acid and heat tinted. The martensitic structure in spot is possibly due to presence of Fe_3C. Magnified 1200 diameters.

causing the weld to break along the line of the V, thereby greatly decreasing its tensile strength and elongation. Similar defects are liable to be in the body of the weld where it has been poorly made but they do not exist in a properly made weld. The burning out of carbon and the presence of oxide dots cannot be avoided and they are the only defects which should exist in a good oxy-acetylene weld.

The grains are frequently columnar, their long axes being perpendicular to the surfaces of the V's in the original material, Fig. 26. The layers of metal applied later refine the grain of the first layers, changing the columnar structure to an equi-axed one, so that some discretion must be used in interpreting this and other features of such welds. The reason for the columnar structure is the very rapid cooling due to the concentration of the heat to a very small area. The same result is produced in ordinary steel ingots by the cold walls of the molds. The usual structure of electric welds is shown in Figs. 27 and 28. In all fusion welds, there is a zone at some distance from the weld line in which the grain is much finer than in the original material, Fig. 12. This zone is further away from the weld with the oxy-acetylene than with the electric process. Its distance varies with the thickness of the piece, being greater with thicker pieces, and is about 1¼ in. in the case of a gas weld made in ¾-in. steel plate. Electric welds contain larger amounts of oxide than do oxy-acetylene welds and they are also much more subject to defects in the form of oxide films and slag pockets for reasons already explained.

All steels contain some nitrogen, but because there are many difficulties in the way of making analyses, not only for nitrogen, but for other gases or their compounds, and in view of the newness of the subject, it is not to be wondered at that there is no accurate data as to the amounts of nitrogen in welds. Reasoning from analogy, however, it is probable that the average electric weld contains something in the neighborhood of 0.20 per cent. nitrogen which, if the formula of iron nitride be Fe_2N, would give 1.80 per cent. iron nitride. The appearance of an electric weld would lead one to believe that there is at least this amount of iron nitride present. The appearance of iron nitride varies from that of exceedingly thin plates of brilliant white material to masses of some size. The plates are exceedingly thin, being probably, at times, of the order of 0.00001 in. thick, and in many cases they appear in an etched section as dark lines of some thickness, but this is doubtless due to the acid eating off the corners of the metal next to the plates and making a groove which of course shows dark in the miscroscope. These plates lie along the same planes in the grains as do the Neumann lines, and do not lie along the slip planes. It is doubtless for this reason that they have but little effect on the strength of distortion of an electric weld. As the amount of nitride increases, it collects in large masses which finally appear as eutectoid. In the writer's opinion, these masses of iron nitride contain some iron carbide because parts of the spots darken with sodium picrate etching or with heat tinting, while in pure nitride there appears to be no such effect, Fig. 29.

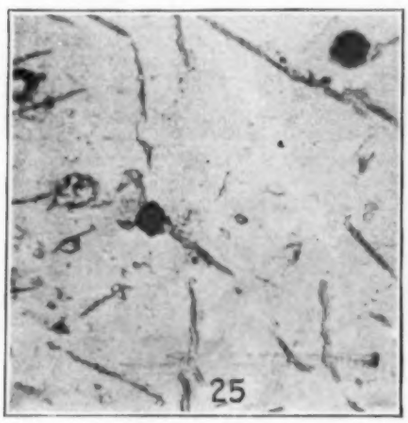
In Conclusion

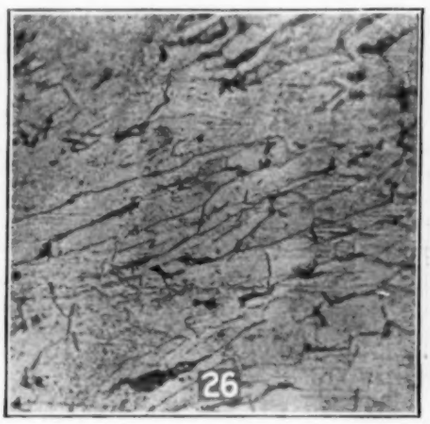
To sum up, the writer feels that, duly considering the qualities of welds, there are many forgings to which fusion welding processes can be applied with perfect safety and that probably they could be profitably extended beyond their present application, if sufficient time were spent in investigating the possibilities.

Tractors for Japan

Advices from engineers in Japan seem to indicate that steam-driven tractors are more suitable and will have a better opportunity of success than those driven by internal combustion engines, which, for the most part, are designed to use gasoline or the lighter oil fuels. The simplicity of a steam engine, the strength of its construction, its easy handling and repair are believed to give it advantages over motors of the other type.

It is true that the price of coal has been constantly going up, but the same is true of all fuels, still leaving the cost in favor of the steam-driven machine.





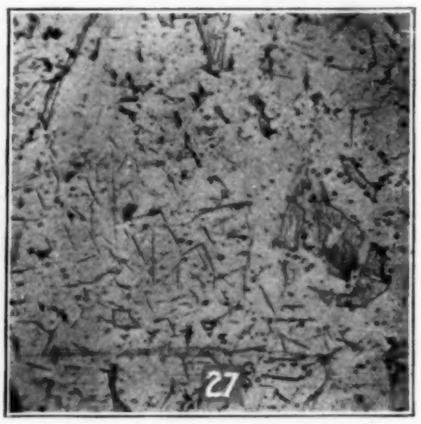
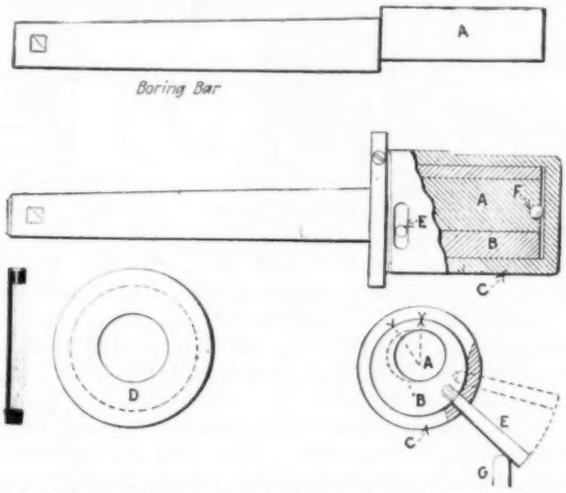


Fig. 25. Iron nitride plates on top of oxy-acetylene weld. Section of surface taken from top ⅛ in. of weld, which also shows oxide dots. Magnified 1200 diameters. Fig. 26. Electric weld showing columnar structure. Magnified 430 diameters. Fig. 27. Usual structure of an electric weld. Showing iron nitride eutectoid and plates and many oxide dots. Magnified 430 diameters.

A Taper-Boring Tool for a Turret Lathe

By W. H. Addis

It is often desired to provide a taper-boring fixture for the turret lathe. Owing to the fact that the turret revolves, it is necessary that such a tool should be compact and self-contained and to bore perfectly true. It is evident that if a taper hole is to be bored by a turret tool, that the tool must have some means of lateral motion that is in a certain controllable relation to the linear travel of the turret. In the tool described below, this is obtained by a combination of



A TAPER-BORING TOOL FOR A TURRET LATHE

a boring bar housed in an eccentric bushing which is clamped in the turret and its partial rotation is actuated by a lever which is raised by a cam placed on the machine bed.

In boring a taper, the eccentric bearing of the boring bar *A* should be thrown off center double the desired taper. The eccentric bushing *B* which is turned and ground so that it fits the bore of the housing *C* and the eccentric bearing of the boring bar *A*, has an eccentricity equal to that of the boring bar. The bushing *C* has a slot milled in the side which permits the feed lever *E* to be screwed into a threaded hole in the eccentric bushing *B*. The ball bearing shown at *F* is seated in the center of the boring-bar bearing and serves as a pivotal support. When the tool is properly set, the cap *D* is screwed on and locked by a setscrew. The hole in the cap must be large enough to permit full lateral movement. The tool is clamped in the turret and an incline guide or cam *G*, whose setting is the same as the taper, is provided. The feed lever *E* raises as it follows the cam, thereby gradually imparting the lateral feed to the boring bar.

There is no danger of the bar digging into the work since the left-hand rotation of the lathe spindle keeps the feed lever firmly in place as it travels along the cam.

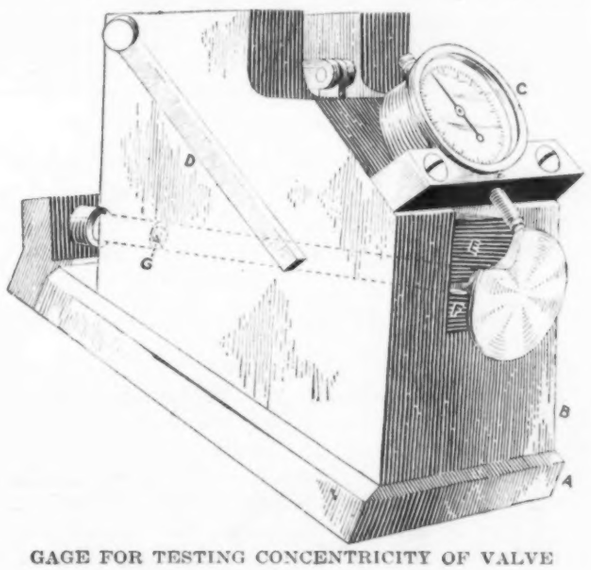
A Concentricity Gage for Poppet Valves

By J. L. Harp

The accompanying illustration shows a gage for testing the concentricity of the valve face with the stem of the ordinary form of poppet valve, this relation being of great importance.

The gage can be made in any toolroom to suit the work in hand. It consists of a base *A*, body *B* and dial indicator *C*. All of the smaller parts are mounted in the body except the stop which is fastened to the base.

The dial indicator is mounted at an angle of 45 deg. and has provision for a small amount of adjustment



GAGE FOR TESTING CONCENTRICITY OF VALVE

to take up wear on the stem. To use the gage the lever *D* is pressed down slightly with the left hand, thus compressing a spring and raising the part *E* which has a radius cut $\frac{1}{16}$ in. deep to fit over the valve stem. The valve is slipped into the two V-blocks *F* with the right hand, the lever which has been held down with the left hand now being released. The valve is thus held firmly in the V-blocks by the part *E* and its spring, while the end thrust is taken by the hardened-steel ball

G which is mounted in such a way as to be free to turn, but cannot drop out.

The stem of the indicator bears at right angles to the ground face of the valve. The valve is turned a complete revolution and back again, with the fingers or with a screwdriver or other suitable tool which fits into the head of the valve, and by watching the dial the relation between the face of the valve and the stem can be ascertained.

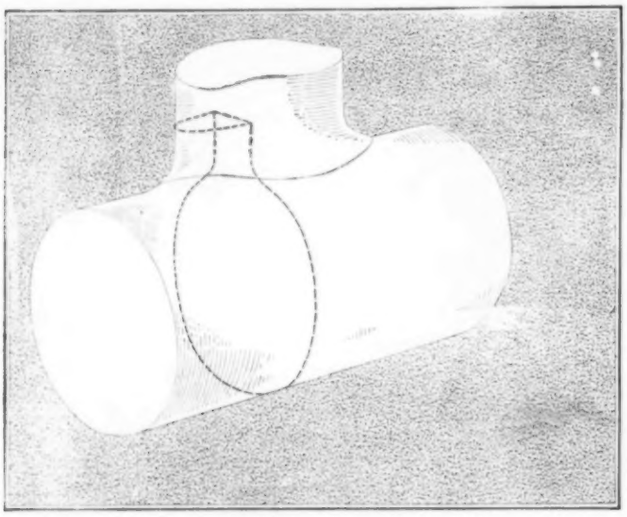
The valve is inclined 20 deg. in order to bring it into a convenient position for the operator.

Making Patterns for Mating Parts

By Adolph Moses

An easy way of getting irregular-shaped castings to fit together nicely is to make the pattern of sections which are glued together with paper in the joints while doing the carving.

The pattern is then pulled apart and finish pads



PATTERNS FOR MATCHING PARTS

placed on the surfaces to be machined. A slight groove at the joint of the finish pad will enable one to make a quick set-up when finishing and show how much finish has been allowed. The sketch shows the idea.

A Device for Shouldering Long Rods

By R. P. Deane

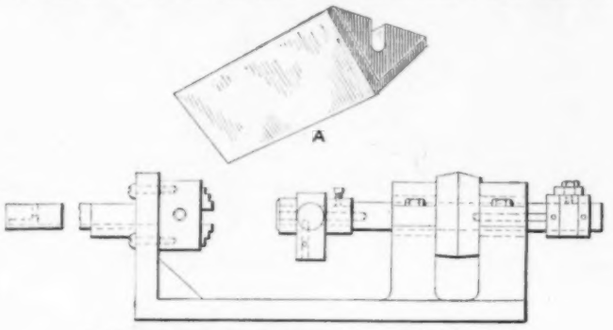
One of the components of the cylinders of paper-making machinery is a $\frac{5}{16}$-in., round brass rod shouldered on each end to $\frac{1}{4}$ in. in diameter.

These rods range from 10 to 16 ft. in length according to the machine upon which they are to be used, and a very essential detail is that the distance between shoulders of all rods that are going in the same machine should be exactly alike.

It requires a considerable number of these rods to each cylinder, and it is desirable that all rods of the same nominal measurement should be to exact length so that they may be made up in quantities. The sketch shows a device that I rigged up to do the shouldering.

A base casting was made with two pedestals for bearings and a bracket at the opposite end to attach the guide for the rods. A pulley with long hubs was fitted to run in the bearings the outside of the hubs forming the journals. The bore of the pulley accommodated a splined spindle carrying at its inner end a box tool for forming the shoulder and at the outer end a pair of collars and a yoke through which the spindle is moved lengthwise by means of a hand lever.

A small universal chuck attached to the inner face of



DEVICE FOR SHOULDERING LONG RODS

the bracket grips the rod to be shouldered. A piece of angle iron is screwed to the bracket in such manner as to form a shallow trough extending to the left a sufficient distance to accommodate the longest rods, being supported throughout its length on suitable trestles.

A gaging piece shown at *A* may be clamped at any position in this trough and serves to locate the shoulders accurately to the correct measurement.

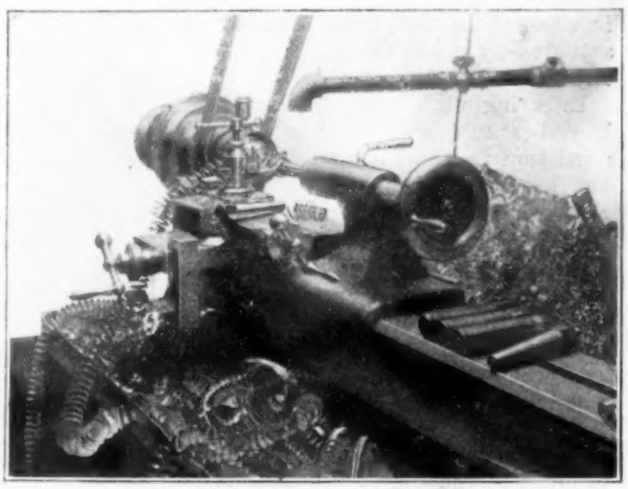
Quantity Production From a Bench Lathe

By E. Ferber

The illustration shown with this article does not represent shell turning in a munition shop, but is an example of how a quantity of pieces may be made without special equipment when that quantity is hardly sufficient to warrant tooling up an automatic.

The piece is of brass, made from round bar stock about $1\frac{3}{16}$ in. in diameter, and the turned portion is tapered from $\frac{5}{16}$ to $\frac{1}{2}$ in. The machine is a Potter precision bench lathe.

The pieces are first milled hexagon on one end and centered upon the other. They are then held in a collet, the compound slide rest set at the correct angle to produce the taper, and the stock removed at one pass of the tool with the lathe running about 900 r.p.m.



THE BENCH LATHE AS A PRODUCER

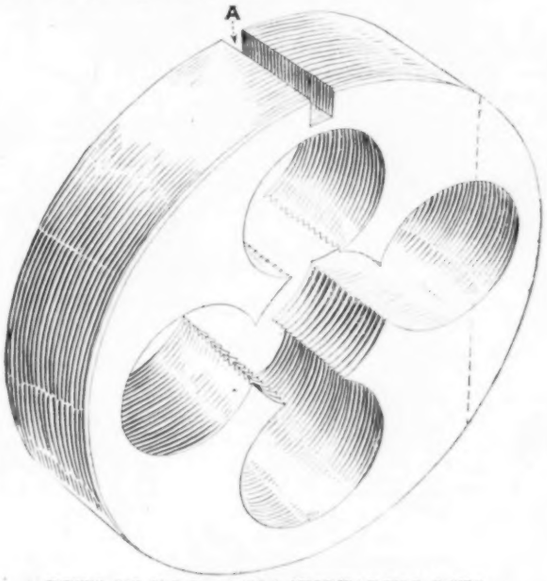
The use of the round stock was a temporary expedient, as it was impossible to get a sufficient quantity of hexagon stock in time to meet the requirements.

When using the round stock the depth of cut ranged from $\frac{1}{4}$ to $\frac{5}{32}$ in.; the feed, being gaged by the sense of feeling, is not known, but the boy who removed the chips had to work harder than the man who produced them.

A Kink in Tempering Round Dies

By M. H. Potter

Trouble is often experienced in hardening and tempering the ordinary form of round threading dies in their going out of shape. This can be overcome by the following described method.



KINK IN TEMPERING THREADING DIES

After the machine work on the die is finished, the slot at *A* is cut to provide adjustability, but instead of cutting it clear through, a wall about $\frac{1}{32}$ in. thick should be left. The die is hardened in the usual manner and tempered by dipping it edgewise into the lead bath up to the point indicated by the dotted line. Repeat this dipping quickly upon the other three sides and the contained heat will then be sufficient to draw the cutting edges to the proper temper. When the die is cold the slot *A* can be cut through with a thin elastic wheel.

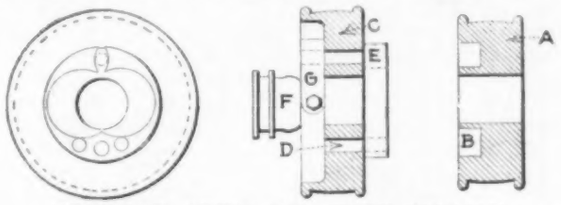
Extra Work-Spindle Drive on Landis Grinding Machine

By John Miles
Keilor, Australia

Desiring to be able to drive the work spindle of our Landis grinding machine for the purpose of indicating work in the chuck without the accompanying noise, vibration and splashing incident to having the whole machine in motion, we fitted the device shown in the sketch which works very satisfactorily.

The pulley *A* is supplied with the machine and is fixed to the left-hand end of the work drive shaft of the counter, its purpose being to drive the feed mechanism. This pulley is recessed as shown at *B*. A pulley *C* was made a running fit on the shaft, and to it is attached an iron split ring supported by the pin *D* and expanded by the cam *E* which is turned slightly by means of the cone *F* engaging the lever *G*. The expanding ring works in the recess *B* of the pulley *A*. Pulley *C* is driven by a 1-in. belt from the line shaft.

Now when setting work in the chuck, a movement of the lever actuating the cone *F* clutches the already moving pulley *C* to the pulley *A*, thus driving the work



AUXILIARY DRIVE FOR WORK SPINDLE

spindle and feed movements without starting the heavier and higher-speeded parts of the machine.

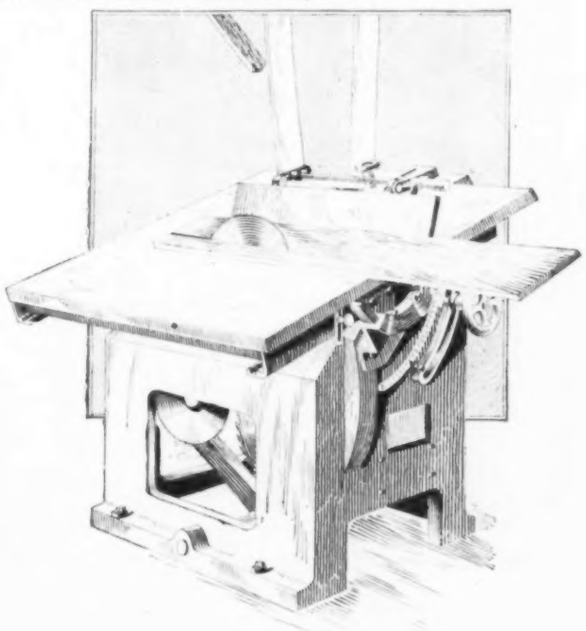
We have found this device to be very handy for setting the wheel travel dogs, as the wheel can be traversed up and down past the work without revolving, which is much safer, as it is an easy matter to let the wheel run into a driving pin on the faceplate before the dogs are correctly set.

Safety First on a Circular Saw

By M. E. Dugan

The cut shows a not unusual arrangement of a circular saw table with the belt shifter over the saw. In order to reach the lever the operator steps to the side of the table and in reaching over, thoughtlessly places one hand on the table to steady himself. This practice results in many accidents.

Too much care and forethought cannot be exercised in locating the belt shifter on machinery of this class. The lever should be so placed that it is at all times within easy reach of the operator when he is standing in the usual position, whether there is a board on the table or not. The use of the other hand for balancing purposes will then be unnecessary.



LOCATION OF BELT SHIFTER

Chart for Use in Appraisal of Standard Machine Tools to Determine Service Value

(A) In using this chart ascertain from best sources, as completely as practicable, preferably from shop superintendents, foremen, U. S. inspectors or plant records, for each tool or group of tools:

1. Actual time of use in years.
2. Average number of hours per day in use.
3. Class of usage and upkeep (see curves below).

(B) Reduce the actual time of use (A1) to the equivalent standard 8-hr. day usage by the reduction factor obtained from small chart on the right.

(C) Enter main chart below with equivalent years of use (B) on base line, read vertically to appropriate curve (A3), then horizontally to left for percentage of condition. This percentage is to be recorded on inventory card unless altered in accordance with paragraph following (D).

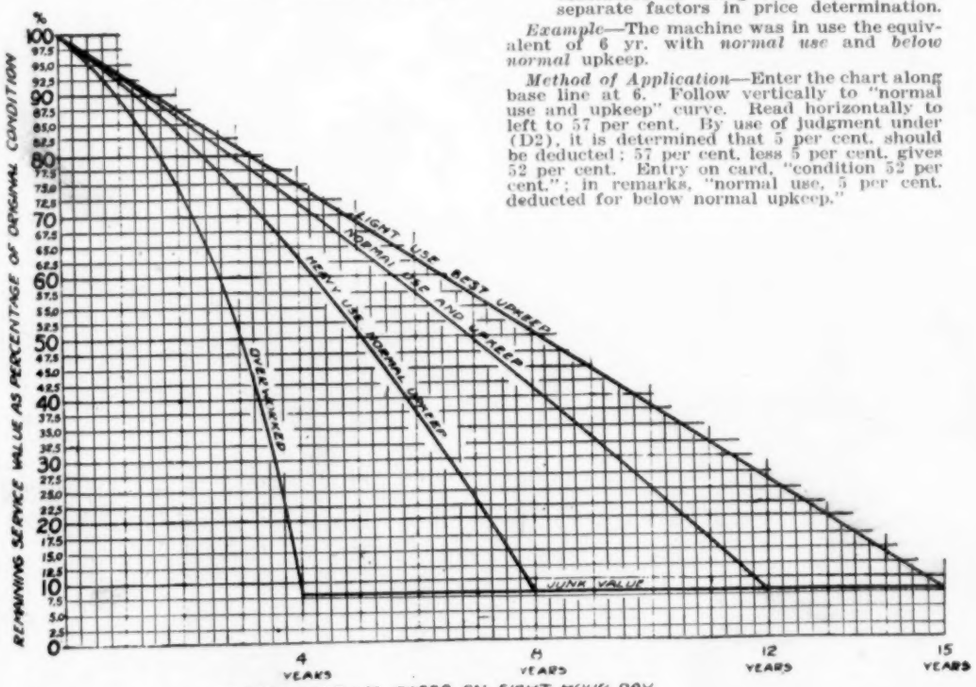
(D) Examine the tool for evidences of:

1. Exceptionally good care maintenance and operation. Above normal, if justified, the percentage derived under preceding paragraph (C) may be increased, but not to exceed five (5%) per cent.
2. Abuse or exceptionally poor care, either in usage, upkeep, handling or storage, below normal, if justified the percentage derived from preceding paragraph (C) may be decreased, but, in general, not more than ten (10%) per cent. The use of the *overworked* curve will cover most cases.
3. Broken or missing standard parts or equipment. This can be taken care of by an appropriate reduction from the percentage previously determined, unless cost of replacement can be estimated with reasonable accuracy, which is preferable.
4. The percentage determined by consideration under paragraph (C), as altered under paragraph (D), is to be entered on the inventory card, and noted in "remarks" with brief statement of reasons for the exercise of special action.

(E) Original cost, market price, obsolescence, amortization and demand are not to be considered in using this chart, but as separate factors in price determination.

Example—The machine was in use the equivalent of 6 yr. with *normal use* and *below normal* upkeep.

Method of Application—Enter the chart along base line at 6. Follow vertically to "normal use and upkeep" curve. Read horizontally to left to 57 per cent. By use of judgment under (D2), it is determined that 5 per cent. should be deducted; 57 per cent. less 5 per cent. gives 52 per cent. Entry on card, "condition 52 per cent."; in remarks, "normal use, 5 per cent. deducted for below normal upkeep."



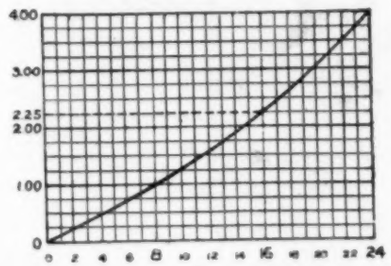
Condition Appraisal Chart

Prepared by conference with various War Department bureaus and the War Industries Readjustment Committee, American Society of Mechanical Engineers.

Approved by this committee as being in accord with best engineering practice by charts and letters. May 23, 1919.

(AAD 440)

Reduction Factor



This chart is to be used in conjunction with the main chart to obtain uniformity of results in those cases where shops have operated at other than 8 hr. per day, on which the main chart is based.

Having determined the number of hours per day at which the tool was operated (A2), read from this number on base line vertically to curve, then horizontally to the side for the reduction factor.

Example—The machinery in the plant was operated for a period of 1¼ yr. (A1) at 24 hr. per day (A2).

Method of Application—From the chart the factor is found to be 4.00 for 24 hr. use. Multiply the period of actual use, 1¼ yr. by factor 4.00. Result 6, which is the equivalent number for years on 8 hr. usage and is the time to be used in reading the main chart.

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MACHINE TOOL SECTION, OFFICE DIRECTOR OF SALES
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Government to Sell Surplus Machine Tools

THE machine-tool section of the office of the Director of Sales, coöperating with representatives of the several bureaus of the War Department, which have a surplus of machine tools, is fixing prices at which all standard surplus machine tools held by the War Department in the United States will be offered for sale. Prices have already been fixed on each machine tool embraced in this purpose which has been inventoried and appraised, and these machines have been listed upon bulletins which are now being distributed to the district salvage boards of the several bureaus with directions that sales of the machines so listed may be made at the prices embraced in the bulletins. Approximately $2,500,000 worth of machine tools are now offered for sale at fixed prices.

The prices fixed are arrived at by the use of a price-fixing chart which is shown in this issue on the following page. In using this chart two factors are taken into consideration; namely, the present condition, or remaining service value of the machine tool, and the present market price of a new machine tool of similar type as determined from the manufacturer's net prices on file in the machine-tool section of the office of Director of Sales. The service value of the machine tools is determined by the use of a graphical appraisal chart which is printed on the preceding page and which has been in use by the bureau of the War Department for several months.

The price-fixing chart was developed by the machine-tool section office of the Director of Sales coöperating with representatives of the several bureaus of the War Department having a surplus of machine tools, and the War Readjustment Committee of the American Society of Mechanical Engineers.

The bulletin from which district salvage boards will make sales contain the particular class, type, size and make of each machine offered; its location by plant, district and bureau; its remaining service value and the selling price. The sales force of each district salvage board is authorized to make sales of all materials listed on the bulletins belonging to its bureau, regardless of whether the machines are located in that or another district. Consequently, a prospective purchaser may obtain full information concerning all machine tools listed from any of the district salvage boards, a complete list of which follows, and make purchases, regardless of where the machinery is located:

Names and Addresses of Office Chiefs

Director of Sales, C. W. Hare, Room 2042; First Assistant Director of Sales, E. C. Morse, Room 2044; Assistants to Mr. Morse, Maj. W. M. Crunden and Maj. H. S. Johnson, Room 2046; Assistant Director of Sales, Guy Hutchinson and A. L. Mercer, Room 2048, 19th and B Sts., Washington.

Administrative Section, Maj. C. S. Shaw, Room 2050; Contractors' Railway Equipment and Building Material Section, W. P. Gleason, Room 2512; Plant Facilities Section, W. G. Sloan, Room 2510; Machine Tools Section, Chas. Hildreth, Room 2047; Motor Vehicles, Vehicles and Aircraft Section, Lieutenant Vandevanter, Vehicles, and Captain Dissetts, Aircraft, Room 2513; Quartermasters' Stores Section, Maj. E. E. Squier, Jr., Room 2502; Ordnance and Ordnance Stores Section, Maj. P. S. Senior, Room 2514; Raw Materials and Scrap Section, Maj. Wm. Wilson, Jr. and Maj. M. J. Connolly, Assistant, Room 2507; Sales Promotion Section, B. A. Mattingly, Room 2515; Contract Section, Maj. Victor E. Ruehl, Room 2501.

Ordnance Department, Sixth and B Sts., Building B; Salvage Board, Chairman, Col. D. K. Shurtleff; Secretary, Building and Equipment, Maj. G. C. Hicks, Jr.; Secretary, Committee on Sales, Maj. A. G. Peter.

Office Director of Purchase and Storage: Salvage Division, Munitions Bldg. 1336, Colonel Nixon; Surplus Property, Munitions Bldg. 1107, L. Birkenstein; Waste Materials, Munitions Bldg. 1321, R. Cunningham; Chemical Warfare, Sixth and B Sts., Bldg. F. Maj. F. E. Breithut; Construction Division, Sixth and B Sts., Bldg. C, Lieut.-Col. Wm. Couper; Military Aëronautics, 4½ and Missouri Ave., Bldg. D, Maj. Harry Graham; Aircraft Production, 4½ and Missouri Ave., Bldg. D, Capt. C. S. Shotwell; Signal Corps, 18th and Virginia Ave., Capt. W. S. Kelly; Engineer Corps, 7th and B Sts., Bldg. C, Maj. W. W. Houston.

Baltimore—Ordnance, 110 East Lexington St., Capt. C. G. Wollson; Salvage Board Commission on Sale of Materials, Bartlett-Hayward Co., Columbia Ave. and B. & O. R.R., Lieut. J. V. Potter; Chemical Warfare, Edgewood Arsenal, Edgewood, Md., Maj. A. M. Heritage; Official Director of Storage, Waste Materials Branch, Coco Cola Bldg., Captain Weyman; Official Director of Storage, Surplus Property Division, Coco Cola Bldg., Capt. H. C. Owen.

Boston—Ordnance, 19 Portland St., Maj. R. E. Friend; Salvage Board Commission on Sale of Materials, 19 Portland St., Lieut. D. E. Dube; Official Director of Storage, Waste Materials Branch, Army Supply Base, Lieutenant Fliney; Official Director of Storage, Surplus Property Division, Army Supply Base, Col. Wm. H. Hart; Aircraft Production Board, 811 Little Bldg., Lieut. David Heald; Signal Corps, Textile Bldg., Colonel Hartmann.

Bridgeport—Ordnance, 945 Main St., Maj. E. T. Walsh; Salvage Board Commission on Sale of Materials, 945 Main St., Lieutenant Peters.

Buffalo—Aircraft Production Board, 2500 Elmwood Ave., Capt. H. Haimon.

Chicago—Ordnance, 155 East Superior St., Lieut.-Col. E. F. Norton; Salvage Board Commission on Sale of Materials, 155 East Superior St., Lieut. N. S. Booth; Official Director of Storage, Waste Materials Branch, 1819 West 39th St., Major Zimmerman; Official Director of Storage, Surplus Property Division, 1819 West 39th St., Maj. O. B. Wilcomb; Aircraft Production Board, Consumers Bldg., Capt. G. C. Greider; Signal Corps, 230 East Ohio St., Col. L. D. Wildman.

Cincinnati—Ordnance, 3rd and Vine Sts., W. H. Hopple; Salvage Board Commission on Sale of Materials, Gwynn Bldg., 6th and Main Sts., Lieut. H. L. Slocum.

Cleveland—Ordnance, 2036 East 22nd St., Maj. H. W. Morris; Salvage Board Commission on Sale of Materials, 2036 East 22nd St., Lieut. R. I. Daley.

Dayton—Aircraft Production Board, Maxwell Motor Co., 1st and B. & O. R.R., Lieut. W. B. Strunk.

Detroit—Ordnance, 828 Rock Bldg., Maj. J. A. Bursley; Salvage Board Commission on Sale of Materials, 828 Book Bldg., Lieut. B. T. Reamey; Aircraft Production Board, A.G.S.D. Springwell, Capt. C. A. Reed.

New York—Ordnance, 1107 Broadway, Maj. W. J. Grinden; Salvage Board Commission on Sale of Materials, Albemarle Bldg., 24th St. and Broadway, Mr. Williams; Chemical Warfare, 19 West 44th St., Lieut. J. M. Pattes; Signal Corps, 8-10 Bridge St., Col C. S. Wallace; Official Director of Storage, Waste Materials Branch, 461 8th Ave., Captain Felix; Official Director of Storage, Surplus Property Division, 461 8th Ave., Capt. R. A. Stewart; Aircraft Production Board. 360 Madison Ave., W. D. Wilkes.

Philadelphia—Ordnance, 1710 Market St., I. H. Francis; Salvage Board Commission Sale of Materials, 1710 Market St., Maj. W. Henderson; Official Director of Storage, Waste Materials Branch, 21st and Oregon Ave., Maj. L. Massie; Official Director of Storage, Surplus Property Division, 21st and Oregon Ave., Major Jones.

Pittsburgh—Ordnance, Chamber of Commerce Bldg., Capt. W. M. Hogg; Salvage Board Commission on Sale of Materials, Chamber of Commerce Bldg., Lieut. G. C. Heistermann; Aircraft Production Board (comes under Buffalo District).

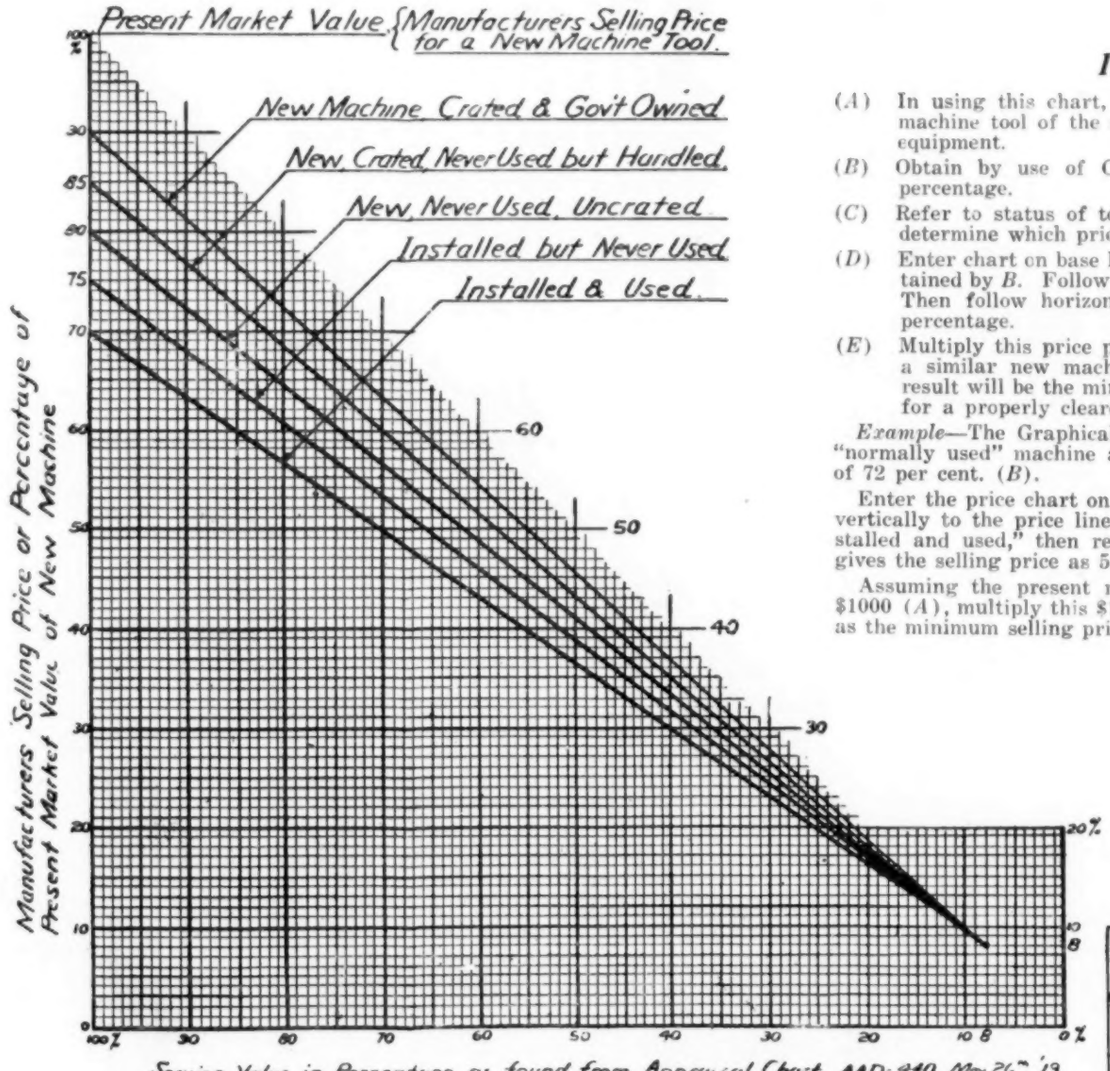
Rochester—Ordnance, 82 North St. Paul St., Maj. W. M. Hasberg; Salvage Board Commission on Sale of Materials, 82 North St. Paul St., Lieut. B. S. Clime.

St. Louis—Ordnance, 613 Locust St., Maj. G. W. Steel; Salvage Board Commission on Sale of Materials, Missouri State Life Bldg., Lieut. C. A. McMullen; Official Director of Storage, Waste Materials Branch, 2nd and Arsenals, Lieutenant Jones; Official Director of Storage, Surplus Property Division, 2nd and Arsenals, Lieutenant Jones.

San Francisco—Aircraft Production Board, 504 Postal Telegraph Bldg., Lieut. R. C. Jordan.

Price Fixing Chart to Determine the Selling Price of Standard Machine Tools.

Showing the Minimum Selling Price without obtaining Special Authority


Present Market Value {Manufacturers Selling Price for a New Machine Tool.
New Machine Crated & Govt Owned
New, Crated, Never Used but Handled.
New, Never Used, Uncrated
Installed but Never Used
Installed & Used.
Manufacturers Selling Price or Percentage of Present Market Value of New Machine
100 90 80 70 60 50 40 30 20 10 8 0
Service Value in Percentage as found from Appraisal Chart AAD-440 May 26th '19

Instructions

(*A*) In using this chart, ascertain present market price of a new machine tool of the same size and make and having the same equipment.

(*B*) Obtain by use of Chart AAD-440 the condition of tool in percentage.

(*C*) Refer to status of tool regarding crating, installation, etc., to determine which price line is to be used.

(*D*) Enter chart on base line with the condition percentage as ascertained by *B*. Follow vertically to price line as ascertained by *C*. Then follow horizontally to the left margin and read price percentage.

(*E*) Multiply this price percentage by the present market value of a similar new machine having the same equipment and the result will be the minimum selling price which may be accepted for a properly cleared surplus machine tool.

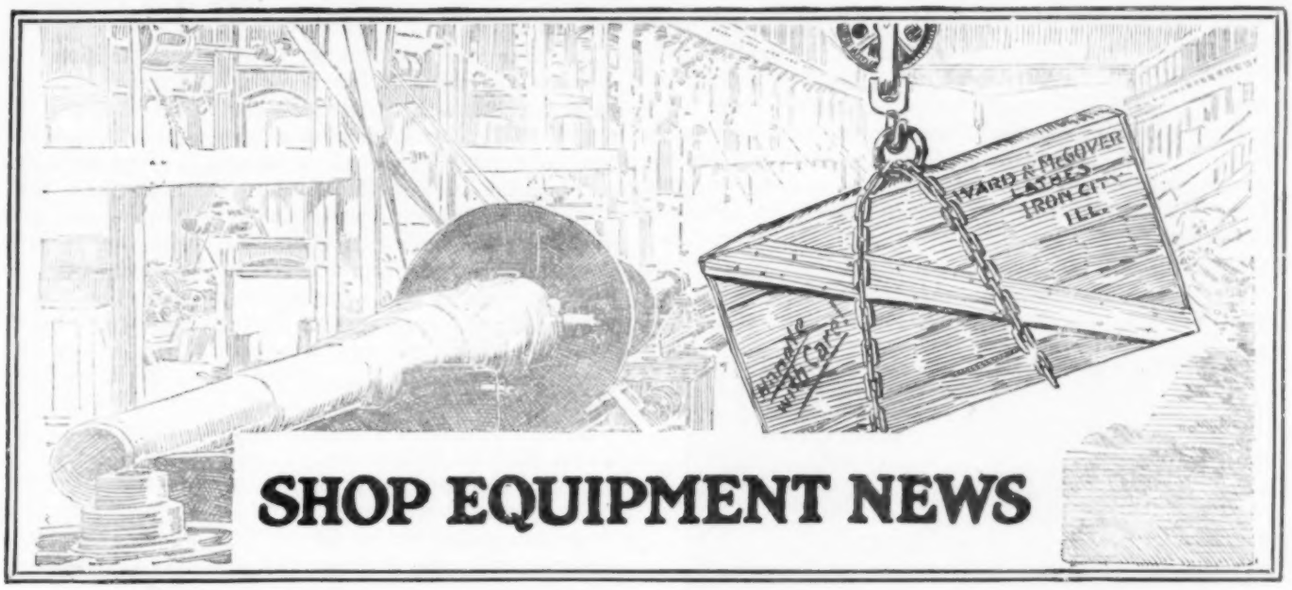
Example—The Graphical Appraisal Chart AAD-440 shows that a "normally used" machine at the end of 4 years has a service value of 72 per cent. (*B*).

Enter the price chart on the base line (*D*) at 72 per cent. Follow vertically to the price line (*C*), which in this case is taken as "installed and used," then read horizontally to the left margin, which gives the selling price as 51 per cent. of the present market price.

Assuming the present market price of a similar machine to be $1000 (*A*), multiply this $1000 by 51 per cent. (*D*), which gives $510 as the minimum selling price.

PRICE FIXING CHART

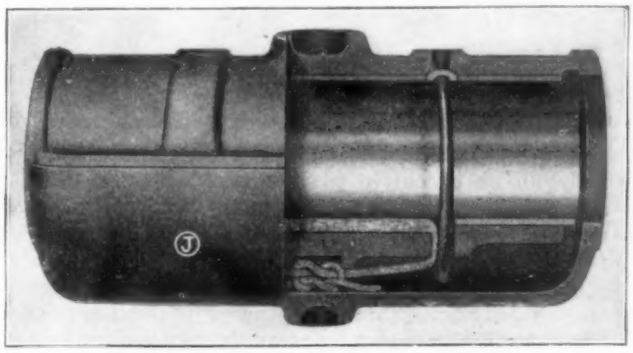
Machine Tools Section
Office of Director of Sales P.S.&T.
General Staff, War Dept. Wash D.C.
Approved [illegible] Chief
J. C. Rushing Ass't. Chief
Drawn by D Letham Date 6-24-19
DRAWING CLASS C NO 6



SHOP EQUIPMENT NEWS

Jones Duplex Oiling Hanger Box

The hanger box shown in the illustration is made by the W. A. Jones Foundry and Machine Co., Chicago, Ill. The bearings are babbitted and accurately bored to size. As the sectional portion of the cut shows, the bearing

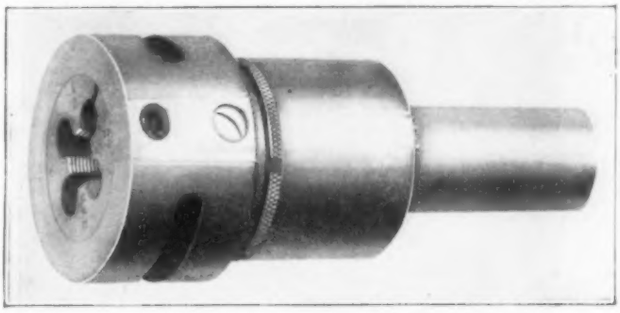


JONES DUPLEX OILING HANGER BOX

is oiled by both wick and rings from a reservoir in the base. The end construction is such that oil working out at the ends of the bearings and thrown off by the shaft is caught in pockets and returned to the reservoir in the base. These boxes may be had from stock in all of the standard shaft sizes.

"Ideal" Tap and Die Holder

The tap and die holder illustrated is being marketed by the Ideal Brass Works, 560 North Elder Ave., Indianapolis, Ind. It is of the releasing type, the drive being through fixed driving pawls and floating driven pawls to fixed driven pawls. The driven pawls are carried on a collar which is located by a large coil spring and the floating pawls used for ordinary right-hand rotation may be replaced by others for left-hand rotation. A slight floating movement is provided for to permit the tap or die to center itself in the work and the parts are hardened and ground. For increasing the range of work a die adapter as shown in place in the figure can be provided. Other special equipment includes a drill holder furnished with hardened bushings for straight-shank drills. A feature of the tap-



IDEAL TAP AND DIE HOLDER

holding bushing is an arrangement by which the tap is held centrally in a round hole which grips the shank of the tap, the squared end fitting into a square hole in the bushing.

Cherrying Attachment for Vertical Milling Machine

The Becker Milling Machine Co., Hyde Park, Boston, Mass., has designed a cherrying attachment for use on different sizes of its vertical milling machines.

This attachment is clamped to the outside barrel or head of the milling machine. A special bevel gear screwed onto the spindle drives through spur gears to the cutter arbor. The minimum diameter cutter which can be used is 1 in. and the maximum, 6 in. in diameter. To allow for different sizes of cutters an adjustable bracket is furnished with idler gear for engaging the gear teeth on the cutter. The attachment is arranged with graduated plate so that it can be swiveled to 360 deg.

Flather 7-Inch Manufacturing Lathe

The lathe described under the above heading on page 289, is known as the "Seven-Inch F. M. C. Lathe" in order to distinguish it from machines made by a company with a somewhat similar name. Inquirers should be careful when writing, regarding this machine, to address their letters to the Flather Manufacturing Co., Nashua, N. H.

Andrew Carnegie

Andrew Carnegie, multi-millionaire, philanthropist, and one-time ironmaster, died at Lenox, Mass., Monday, Aug. 11, 1919. He was in his eighty-fourth year.

Mr. Carnegie was born in Dunfermline, Scotland, Nov. 25, 1835. In 1848 his father was thrown out of employment by the growing use of the power loom, and almost destitute, emigrated with his family to America. He settled in Allegany City, Penn., across the river from Pittsburgh, where he and Andy found work in a cotton mill. Young Carnegie worked there as a bobbin boy for $1.20 a week, but was soon promoted with a slight ad-

ANDREW CARNEGIE

vance in wages to engineer's assistant. At fourteen, the boy emerged from the engine celler and became a messenger for the Ohio Telegraph Co.; learned to use the instruments and became an operator for the Pennsylvania Railroad, and is said to have been one of the first four operators to receive messages entirely by sound.

One of his first steps toward independence and fortune came when he, with T. T. Woodruff and Thomas A. Scott, afterward president of the Pennsylvania Railroad Co., invested some money in the manufacture of sleeping cars. Mr. Carnegie, then earning only $50 a month, had to borrow $200 as his first installment on the capital of the concern which was later sold out to the Pullman Company.

When the Civil War broke out Mr. Carnegie received, through the aid of Thomas Scott, an appointment as director of Government railways and telegraphs. It was while he held this position that he devised a telegraph cipher code to be used in transmitting orders for the dispatch of troops by railway.

In 1862 he went with the Pennsylvania Railroad and soon after this "struck oil" and "struck it rich." As one of a syndicate he bought up a vast tract of Pennsylvania oil land, and in a year, it paid the astonishing return of $1,000,000 in cash dividends upon a capital of $40,000.

But iron was the magnet then attracting him. He foresaw the demand for a plant that could turn out parts for railroad bridges and accordingly founded the Keystone Bridge Works. He then began to see that iron rails must give place to steel. In 1868 on a trip to England he saw the success being obtained there with the Bessemer process. Quietly bringing this process home he adopted it in his own mills, and later he bought more mills, and finally after twenty years, became the world's leading producer in steel. In 1901 his company was bought out by a syndicate headed by the late J. P. Morgan, which formed the United States Steel Corporation, and which paid $420,000,000 in its 5 per cent. bonds for the Carnegie company's holdings. Mr. Carnegie's personal share in these holdings netted him about $250,000,000.

At the time of his death, Mr. Carnegie was the holder of numerous honors and decorations bestowed upon him by rulers and societies all over the world. Altogether he endowed over 3000 municipal libraries beside his other numerous philanthropic enterprises.

Mr. Carnegie became a member of the American Society of Mechanical Engineers in 1890 and in 1907 was made an honorary member. He was also a member of the American Institute of Architects, the American Institute of Mining and Metallurgical Engineers, the National Civic Federation, the American Philosophic Society and the New York Chamber of Commerce.

Why Not Encourage Home Talent?

BY FRED PRICE

That mechanic is rare who does not aspire to eventually fill an executive position and while he may not acknowledge this fact in so many words, the desire nevertheless is there. Thus, many skilled men look forward to the time when their latent ability will be recognized and when they will be advanced, step by step to gang boss, foreman, general foreman or perhaps general superintendent. Instances are on record wherein men have been gradually advanced until a high executive position was reached.

We hear much these days about reducing the heavy turnover of labor. We are taught by the economists that this factor is detrimental to scientific management; yet, when the average manufacturing plant wants an executive, what procedure is generally followed? Invariably a man is obtained from outside sources; for in this manner the plant gains the value of the new man's experience in other fields, thus enriching their own knowledge at the expense of some other manufacturer.

At the same time, the humble mechanic is frowned upon because he roams from job to job that he may gain the experience necessary to fit him for a better position. On the other hand, if he sticks in one shop what are his opportunities for advancement? It is a poor rule that will not work both ways and if a man has grown up in one plant and understands the system of that plant thoroughly he should be advanced when a vacancy higher up is to be filled. Such a procedure would aid materially in reducing labor turnover because it would offer the good mechanic an incentive to put forth his best efforts in the hope that sooner or later his ability will be recognized.

Industrial Conditions in France

By S. S. Buckley

The writer, who has recently returned from an intensive study of industrial conditions in France, is very hopeful of a large volume of business in iron and steel and their products as soon as conditions have become so readjusted as to make this possible. The two controlling conditions seem to be the mental readjustment of the returned soldier, and this means practically every able-bodied man of military age, and the adjustment of finances so that purchases may be made on something near the pre-war basis of exchange.

The writer is inclined to believe that the readjustment of the individual is the greater problem, bearing in mind the effect of every great war on the private soldier. It must not be forgotten that the soldier has to combat several tendencies; in this case four years of strenuous warfare, in which more nerve-racking devices were used than ever before. Then there is the fatalistic tendency of most men who are constantly surrounded by danger; the habit of depending on someone else for every creature comfort, with the accompanying surrender of all initiative; and the antipathy to indoor employment resulting from four years of life in the open.

On the other side of the question we find the business man who has prospered during the war, and who, realizing the possibility if not probability of an unsettled political condition, hesitates about investing all his capital in the business enterprises which are so necessary at this time. It is, in fact, stated that many men who have profited by the war are investing their surplus on this side of the Atlantic, where political conditions are less liable to a radical change.

It is the writer's firm belief that the same persistence and stick-to-it-iveness which carried the French through the war and which has served them well in overcoming the great opposition thrown in the path of their attempts to establish a republican form of government, will carry them through the present crisis. Production, and still more production, is the one thing which will make it possible for them to get industry back to its former proportions, but this will be done as soon as the question of finances and of personnel can be settled.

As a basis for the belief that we are bound to play a large part in supplying iron and steel and their products, a few statistics concerning pre-war conditions are of interest. Previous to the war Europe exported approximately 14,000,000 tons of iron and steel and their products. Of this, Germany exported 5,500,000 tons and Great Britain 4,500,000 tons, Belgium, France, Sweden and Norway making up the balance. Conditions are now so changed that none of these countries can now supply their own needs, this being somewhat controlled by the situation of the supply. It requires from two to three tons of coal to produce a ton of steel, the higher figure being required for tool steel. Coal is now $20 per ton in France and approximately $27 in Sweden, while, according to recent reports, the United States can "carry coal to Newcastle" and sell it for less money than the present cost of mining in Great Britain. This of itself limits the amount of iron and steel that can be produced and indicates a large market for our product for several years at least.

The question of exchange is also of vital importance in resuming trade relations. It will be noted by the commercial reports that exchange at present is greatly to the disavantage of France, Italy, Belgium and Germany. It is also to the disavantage of Great Britain, Sweden, Norway, Denmark, and Spain, but to a much less degree.

In considering immediate selling operations, therefore, the obvious thing is to make a drive in the countries where the exchange is most favorable.

It is also advisable to confine selling efforts to the things which are necessary to those countries, to urge them to get into production as soon as possible and to arrange to purchase their commodities. Only in this way can they buy our products and preserve normal conditions.

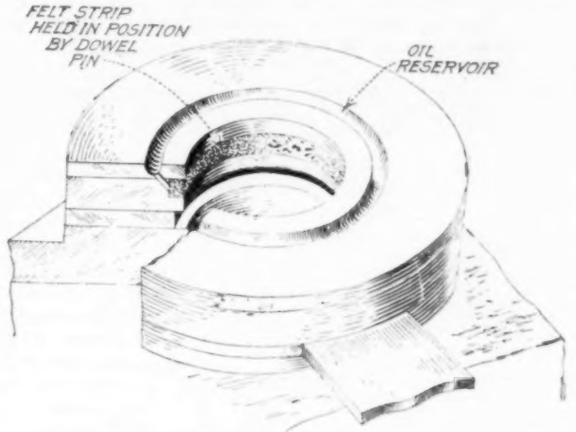
One startling fact presents itself: Germany's vast industrial establishments are but slightly impaired and there is concerted effort on the part of her manufacturers to resume peace-time pursuits. Her people are working hard and producing as never before, while exchange is practically on a par with her neighbors.

If we do not wish to find her a menace to our future trade in these countries, is not this condition the greatest argument that could be made concerning the necessity of our financial men doing everything in their power to correct the exchange rate?

Putting Oil on a Blanking Punch

By Charles M. Lauer

Many times it is desirable to lubricate blanking tools, but to completely cover the stock with oil as is usually done in blanking operations is quite undesirable. The illustration shows the method in which the writer



THE OILING DEVICE

keeps the punch well lubricated without getting any undue quantity of oil on the blanks.

A built-up stripper plate is used which is recessed around the punch opening to hold strips of felt. A groove around the opening in the top plate is connected by means of numerous small holes to the chamber in which the felt is held, and by keeping this groove constantly supplied with oil the felt is saturated and, by rubbing against the punch, keeps the latter properly lubricated.

In making this device, due consideration should be given to the stroke of the press, as it is necessary that the punch shall not draw out beyond the felt after the tools are set.

Sparks from the

Tacony Steel Co. Adds to Plant Equipment

The Tacony Steel Co. and the Tacony Ordnance Corp., Tacony, Philadelphia, Penn., announce the purchase of the latter's plant by the Tacony Steel Co. and the consolidation of the respective metallurgical and manufacturing organizations.

The Tacony Ordnance Corp. was organized in August, 1917, by J. B. Warren, then secretary (now president and general manager) of the Tacony Steel Co., and George Satterthwaite, vice president and treasurer. The consolidation does not affect the officials or management, as the following officers and directors have for some time acted in the same capacity with the steel company and the ordnance corporation: J. B. Warren, president; George Satterthwaite, vice president and treasurer; Henry T. Stetson, secretary; O. W. Bird, Jr., and W. H. Turner, directors.

* * *

Reclaiming Barbed Wire from Trenches

The problem of retrieving the buried and broken barbed wire on the battlefields of Flanders and Northern France is being tackled by the British War Office Salvage Committee, and a machine for the purpose has been invented and built which is thus described:

One trunk and trailer carries the whole of the plant, which can work on the most uneven ground. A stout wire rope with a number of hooks is worked by a winch. As the barbed wire is drawn up it passes through two sets of rollers and the salved metal appears in blocks from one foot to 18 in. square, and weighing from 70 to 80 lb. For smelting it sells for about $25 a ton. The staff in charge of the scheme thinks that there are 100,000 tons that can be removed, and if that is the aggregate weight, the cost of the 40 outfits said to have been ordered should be amply justified.

* * *

Danger in Scrap Pipe from Explosive Works

Dealers in, as well as original sellers of, iron and steel scrap from explosive plants are warned by the Bureau of Explosives, New York, in a special bulletin, to guard against explosions caused by guncotton, picric acid, or TNT inside of pipes or receptacles. The following are instances of such accidents: Damage to a metal plant in the melting down of lead pipe containing picric acid; explosion in a storage yard because of contact of a lighted match with nitrocellulose; the severing of a hand from an explosion resulting from the crushing of pipe between two hammers; killing of employees cutting up pipe from the oil fields of Oklahoma, in which a detonating cartridge had been left. One explosive company makes a double inspection of all pipe leaving its plants; it is first burned in a woodpile and then inspected, each piece being marked with red paint; after it is loaded on cars another inspection is made, markings with blue paint indicating it.

Personals

E. R. FREDERICK has resigned as president of the Allied Machinery Co. de France. He plans to remain in Paris.

TELL BERNA, formerly district manager for the Cutler-Hammer Manufacturing Co., Cincinnati, Ohio, has become associated with the G. A. Gray Co., Cincinnati, Ohio, as sales engineer.

W. C. TYLER, New York district manager for the Poole Engineering and Machine Co., Baltimore, has been appointed general sales manager, the office having been moved from Baltimore to New York.

SERGEANT PAUL MITCHELL of the Provisional Supply Depot, A. E. F., has returned from France and has resumed his duties as traveling representative for the Independent Pneumatic Tool Co., Chicago, Ill.

MAJ. W. W. TANGEMAN has recently returned from service in the Ordnance Department of the U. S. Army in France and is re-associated with the Cincinnati Milling Machine Co., Cincinnati, Ohio, as sales engineer.

J. L. CANBY has been appointed district manager of sales at Chicago, of the Chicago Pneumatic Tool Co., succeeding NELSON B. GATCH, who has been transferred to New York as district manager of sales.

BYRON F. STOWELL, for many years connected with the Hendee Manufacturing Co., Springfield, Mass., as master mechanic and mechanical engineer, has accepted a position with the Napier Saw Works, Inc., Springfield, Mass.

DANIEL H. HUNTER has been appointed sales manager of the Sullivan Machinery Co. for Louisiana, Texas (except the southwestern section), and the oil fields of Oklahoma and Kansas, with headquarters in Dallas, Texas.

A. E. KAISER, who has been assistant to the director of production, of the Westinghouse Electric and Manufacturing Co., East Springfield, Mass., has been appointed director of production, to fill the vacancy made by A. B. Reynders' promotion.

N. S. BRADEN, formerly sales manager, has recently been elected vice president of the Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada. H. M. BOSTWICK, assistant sales manager, has been appointed sales manager, to fill the vacancy made by Mr. Braden's promotion.

H. A. REED has been made divisional sales manager in the Southwest for the Hart-Parr Co., Charles City, Iowa. For the past six months he has been managing the reorganization of the road engine department of the company. Previous to that Mr. Reed was for five years manager of the Hart-Parr branch at Great Falls, Mont. His headquarters will be at Kansas City, Kansas.

ARTHUR B. REYNDERS, former director of production of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Penn., has recently been made works manager of its plant at East Springfield, Mass. Mr. Reynders is a member of the American Institute of Electrical Engineers, the Engineers Society of Western Pennsylvania, and the Association for the Advancement of Science.

A. O. MUNSON, of Waterloo, Iowa, leaves this month for Europe, where he will represent the International Harvester Co. His headquarters for awhile will be at Brussels. He will particularly push the sales of plows for his company and will travel in Belgium, France, Holland, Great Britain, Spain, Italy and the Scandinavian countries. Mr. Munson's headquarters were formerly in Moline, Ill. and for three years he represented the Parlin and Orendorff company at Canton, Illinois.

Foreign Trade Council Plans 1920 Convention

Preparations for the Seventh National Foreign Trade Convention, to be held in San Francisco May 12-15, 1920, are now actively under way.

James A. Farrell, chairman of the National Foreign Trade Council, has appointed a Pacific Coast Convention Committee of the Council, consisting of H. F. Alexander, Tacoma; J. K. Armsby, Robert Dollar, Frederick J. Koster, San Francisco; J. J. Donovan, Bellingham; M. H. Houser, Portland, and William Pigott, Seattle. The executive committee will consist of the San Francisco members.

* * *

Orders for Locomotives

The American Locomotive Co., Schenectady, N. Y., has received an order from the United States Railroad Administration for 25 locomotives to be used on the Texas & Pacific Railroad; 18 of the engines will be of Sante Fe type and seven of Pacific type.

The Baldwin Locomotive Works, Philadelphia, has practically closed with the Polish government for a number of locomotives, totaling in amount about $7,000,000. It has also sold eight locomotives to the Tata Iron and Steel Co. for 5 ft. 6 in. gage tracks.

World's Industrial Forge

By E.C.Porter
News Editor

Plans Exhibit of Army Motorized Ordnance Equipment

Plans for an exhibit of the Army's motorized ordnance equipment, together with the captured German trucks parked at Camp Holabird, Md., are being considered by the National Automobile Chamber of Commerce and the Society of Automotive Engineers. It is proposed to seek Government sanction and coöperation for housing the machines at a convenient point, so engineers and manufacturers may study particularly the German equipment, with a view to obtaining suggestions for improvement of future truck designs.

* * *

Picnic of Chicago Machinery Club

The Chicago Machinery Club will hold its fourth annual picnic in Thatcher's Woods, River Forest, Ill., Saturday afternoon, Sept. 6, 1919. There will be all kinds of amusements for everyone, of course, but the big event of the day will be the ball game between the Peddlers and Order Takers, or more plainly speaking, the supply men against the machine-tool men. The supply team will be managed, as before, by Clyde Blakeslee and captained by Ray Jones, while the machine-tool team still retains Peterson as its manager, with Van Buren as captain.

* * *

Beginning of a New Era

Secretary of War Baker referred to the departure of the U. S. Army motor-truck train from Washington, D. C., as "the beginning of a new era" and designated the world war as a "war of motor transports." The journey is designated as "the War Department's contribution to the good roads movement for the purpose of developing the through route and transcontinental highways as a military and economical asset." That military opinion, both in America and with the American expeditionary forces abroad, favors a comprehensive federal road plan, is becoming increasingly apparent.

* * *

U. S. Machinery Demand Increasing in Europe

"American machinery and other products are coming into ever-increasing demand in France, Italy, Belgium and other war-devastated countries," says F. H. Dodge, of Detroit, who has just returned from Europe. Mr. Dodge, who is sales director for the Burroughs Adding Machine Co., predicted the demand would continue throughout the reconstruction period. He spent four months abroad.

"Foreigners who come into contact with American methods during the war," said Mr. Dodge, "have been bitten by the efficiency bee. As an instance in point, my firm formerly disposed of only one-eleventh of its output in France, Italy and Belgium. The outlook now is that we shall send half our production to these countries."

Business Items

The Western Manufacturing Co., Oskaloosa, Iowa, has completed a new building, 42 x 126, and has installed a number of new machines. This company, it is reported, will increase its working force about 30 per cent.

The Pawnee Tire and Rubber Co. has been incorporated at Waterloo, Iowa, as a $1,500,000 manufacturing company. Charles F. Sawyer is president of the company. The other incorporators are E. D. Flynn, E. D. Flynn, Jr., W. J. and Elmer Murphy.

The Tool Engineers Sales Co., 817 Kresge Building, Detroit, Mich., has been organized by J. E. Livingstone and W. D. Myles formerly of the Maxwell Motor Co., Inc., for marketing the products of the American Broach and Machine Co. and the Ypsilanti Twist Drill Co. in the State of Michigan.

The Ellis Engineering Co., 621 West Washington Blvd., Chicago, Ill., has taken over the Illinois and Wisconsin agency of the small-tool department of the Becker Milling Machine Co., Hyde Park, Mass. The E. L. Essley Machinery Co., 555 West Washington Blvd., will continue to handle their milling machines as in the past.

The Dalton Manufacturing Corporation, 1915 Park Ave., New York City, manufacturer of lathes and drilling machines for metal working, has purchased several acres of ground at South Beach, Conn., and will erect a new factory. Contracts for four buildings, and power house have already been placed, and the firm expects to occupy the new factory by Jan. 1, 1920.

The American Engine and Tractor Co., Charles City, Iowa, has changed its name to the American Tractor and Foundry Co. It is now open for business at its plant here. This company will manufacture stationary engines until the factory gets into full operation, when its tractors will be put on the market. C. C. Butler of Minneapolis has been appointed works manager. W. L. Joyce is vice president and manager.

Trade Currents from Cleveland and Chicago Districts

CLEVELAND LETTER

In the opinion of some of the foremost machinery interests of this district, more business has come forward in the local machinery and equipment market since Aug. 1 than in any similar period since the war ended. A significant development in connection with this improvement is that while the principal demand is from automobile manufacturers, a larger number of general manufacturers, such as accessories, equipment and auto-parts makers, textile-machinery makers and the like, are coming in heavier. There is no boom, but distributors and machinery makers point out a steady improvement created by orders for one and two pieces of equipment from all sources. Another change noted is that most of the business, with few exceptions, is for standard equipment which most firms can fill on short notice. The result is a period of activity almost as great as that a year ago at this time, and that was about the busiest in the history of the industry in this district.

Marked change in the foreign trade has developed since the beginning of the month also. While some firms are waiting for improvement in export conditions and see no relief for a year or so to come, from the high exchange rate, lack of capital, waiting upon indemnities, and the Government machinery being sold abroad; others are going ahead under these handicaps.

For example, during the last week one lot of milling machines, totaling a valuation of $35,000, was shipped from Cleveland for distribution in France, Spain, Italy and Japan. Another order from Monterey, Mexico, for general machine-shop equipment has been placed during the week, the cost being $12,000. Several large grinding machines, costing $7000 for the lot, have been purchased for use in a plant at Canton, China. This business is considered good, in view of the chaotic conditions in most foreign countries, and most manufacturers are going after it strong.

The Cleveland Automatic Machinery Co., for example, has commissioned Harry W. Rupple as its special export representative in Europe, and who proposes to tour every country on the continent in the interest of this firm. Mr. Rupple will make his headquarters for the present in Paris. He was formerly identified with the Cleveland concern in production capacity.

The Cleveland Milling Machine Co. is planning expansions in its business in other sections of the country. The D. Nast Machinery Co., Philadelphia,

has been appointed the agency for the Cleveland Milling Machine company's milling and cutting machines in the Philadelphia district, and the J. S. Miller Machinery Co., Pittsburgh, will have the agency for the milling machines in the Pittsburgh territory.

Considerable interest is manifested in the report that the Roumanian and Czecho-Slovak Commission, which is in this country especially to buy machinery for the interests at home, proposes to move its headquarters to Cleveland.

Between now and the end of August a big increase in demand for equipment from structural steel, oil and the bigger automobile interests is anticipated. This surmise is based upon the large amount of industrial and commercial building which is about to be started, the increasing demand for oil products, and the disposition of automobile builders to take advantage of the prosperity of the country as a whole in bringing out their 1920 cars a bit earlier this year. Machinery interests in the latter instance are preparing for the September deliveries expected. The Grant Motor Car Co., a local concern, proposes to increase its capacity to 20,000 cars a year. The Winton Co. is planning a smaller, cheaper six-cylinder car along the lines of its present high-class vehicle. The Cleveland Automobile Co. is near the point where it will begin to manufacture cars. From out of town comes the report that the Stutz Motor Car Co., Indianapolis, proposes to increase its present production of 3000 cars a year, and the Pierce-Arrow interests are considering doubling their present capacity.

One of the projects that will surpass even these and others combined, perhaps, will be the proposed plant for the Willys-Overland, Inc., for Elyria, on the fringe of the Cleveland district. This concern has purchased 100 acres on the outskirts of Elyria, and is said to be planning the immediate construction of a large engine plant. This plant is expected to be used for the production of a new Willys-Knight motor, presumably for a proposed moderate-priced Overland car, and an engine for house-lighting purposes. The plant will employ 9000 men. Machinery interests expect that at least $5,000,000 general equipment will be required for this plant. No confirmation of the plans has been received as yet at Cleveland headquarters of the Overland interests.

Chicago Letter

Those machinery dealers who have a large amount of out-of-town trade are finding their business steadily prospering, August apparently rolling up a sales total equal to if not greater than that made in July. Local trade has fallen off to a certain extent, which is to be expected in view of the widespread industrial troubles. No new strikes or lockouts directly affecting users of machinery have occurred, but the lockout of the building trades, which is about 100 per cent. effective, is having a decided indirect effect.

With the resumption of building activity last spring, dozens and perhaps hundreds of manufacturers, large and small, owners of machine shops and foundries, and industrial concerns of all kinds, immediately commissioned their architects and engineers to prepare plans for extensions, additions, or, in some cases, for entire new plants. Many of these new structures were caught by the lockout in a semi-finished condition. As a matter of course, the owners, in view of undeniably high prices, have postponed the purchase of necessary equipment until such time as operations on their new structures can be resumed.

An encouraging feature of the matter is that when the hammer and the trowel again get busy, a flood of business is bound to result immediately, as the delay will render owners impatient to complete and equip their new facilities. In the meantime, the volume of out-of-town trade is sufficient to keep the machinery dealers busy.

No important price changes have been recorded during the past week. The two or three lathe manufacturers who refrained from a boost the first of the month are still using their old lists, and agitation against high prices makes further increases questionable. Manufacturers who have not increased, however, are undoubtedly facing quite a problem in economics, as their labor and material costs and overhead are certainly at a high point.

Dealers are selling more lathes than any other single item, but punching machines are most in demand; dealers in several lines reporting that their allotment from the factory is sold far in advance.

Catalogs Wanted

Wm. A. Field Co., 208 South La Salle St., Chicago, Ill., is organizing a purchasing department and wants to secure a complete file of catalogs of machinery, machinist supplies, steel and tools.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number.

A firm in Australia wishes to get in communication with the American exporters of electrical wires, cables, conduits, machinery, lamps, fittings, and glassware, metals and metal products, machinery for all industrial purposes, hardware, oils, chemicals, automobiles, and accessories. References. No. 29,964.

The purchase of goods and agency for the sale of agricultural machinery, sewing and knitting machines, typewriters, and marine engines (Diesel type) are desired by a man in Greece. Payment, cash against documents. Correspondence should be in French. References. No. 29,965.

The purchase of machinery, particularly mining machinery and equipment is desired by a firm in Spain. Quotations should be given f.o.b. New York. Payment, cash against documents. References. No. 29,896.

A company in India wishes to get in direct touch with manufacturers of irrigation machinery, kerosene and crude-oil engines, agricultural machinery, stone flour mills, machine tools, hardware, bolts, nuts, set screws, and rice-mill machinery. References. No. 30,018.

A company in England desires to purchase small grooved rolled iron bars in sizes No. 2 full, $\frac{11}{32}$, $\frac{11}{32}$, $\frac{13}{32}$ and $\frac{3}{16}$ in., to be used in the manufacture of brass cased round stair rods. The amount used by this company averages 5 tons per week in assorted sizes. It is willing to submit samplez of what is desired to interested firms. Quotations should be given f.o.b. Liverpool. References. No. 30,070.

An exclusive agency is desired by a firm in Spain for the sale of automobile lighting generators, starting motors, and magnetos. Correspondence may be in English. Reference. No. 30,071.

The agency on a commission basis for all of Italy, of wrought-iron pipe, malleable-iron pipe fittings, steam and water cocks and valves, machinists' tools, electrical supplies, and mechanical lines in general, is desired by a firm in that country. Correspondence may be in English. References. No. 30,058.

The purchase of steel tubes, 2 in. and $2\frac{1}{4}$ in. in diameter, $\frac{1}{8}$ or $\frac{1}{4}$ in. in thickness, and 5½ meters in length, in quantities of 100 tubes of each quality, are desired by a firm in Portugal. Quotations should be given c.i.f. if possible. Correspondence should be in Portuguese. References. No. 30,067.

Forthcoming Meetings

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

American Railway Tool Foremen's Association will hold its ninth annual convention at the Hotel Sherman on Aug. 27 to 29, inclusive. Charles N. Thulin, 935 People's Gas Bldg., Chicago, is the secretary.

The American Steel Treaters' Society will hold its annual convention and exhibition at the Seventh Regiment Armory, Chicago, Ill., Sept. 22 to 27. Al. J. Murphy, 154 East Erie St., Chicago, Ill., is chairman of the exhibit committee.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of the odd months. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meetings at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary, W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

International Railway General Foremen's Association will hold its annual convention Sept. 2 to 5 inclusive, at the Hotel Sherman, Chicago, Ill.

The International Railroad Master Blacksmith's Association will hold its annual convention in Chicago, Aug. 19, 20 and 21. The location of the meeting in Chicago will be announced later. A. L. Woodworth, 752 West N St., Lima, Ohio, is the secretary.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

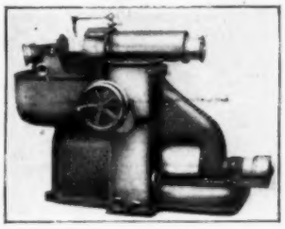
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Tool-Grinding Machine, "Lumsden"

Alfred Herbert, Ltd., 54 Dey St., New York City.

"American Machinist," July 31, 1919.



This oscillating tool-grinding machine is made in four sizes: No. 1, No. 2, No. 2a and No. 3 with respective specifications for the various parts as follows: Largest tool shank handled, 1⅝ x 2 in., 3 x 2 in., 3 x 2 in., 6 x 3 in.; smallest tool shank handled, ½ x ½ in., ⅞ x ⅞ in., ⅞ x ⅞ in., ⅞ x ⅞ in.; diameter of grinding wheel, 12 in., 14 in., 16 in., 16 in.; maximum stroke of wheel, 1¼ in., 1½ in., 1½ in., 2¼ in.; horsepower required, 3, 4, 4, 5; floor space, 80 x 64 in.; 86 x 60 in.; 86 x 60 in.; 93 x 60 in.; approximate net weight, 2912 lb., 3472 lb., 3490 lb., 4592 lb.

Drilling Machine, Sensitive Radial

C. L. Hawes, 12 Adams St., Ashtabula, Ohio.

"American Machinist," July 31, 1919

Capacity, up to ¼ in., distance from column to center of drill, 9 in. minimum, 40 in. maximum, distance from base to end of spindle, 47 in.; finished surface of base, 24 x 34 in.; T-slots in base, 3; size of table, 16 x 29 in.; T-slots in table, 3; travel of table, 18 in.; diameter of largest pulley on spindle cone, 10 in.; net weight, 2300 lb.

Sine-Bar Fixture

Taft-Peirce Manufacturing Co., Woonsocket, R. I.

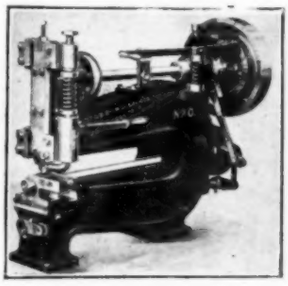
"American Machinist," July 31, 1919.

In this improved sine-bar fixture two clamping nuts are provided, one of which takes care of raising and lowering the pivot point while the other permits the rotation of the sine-bar without changing the height adjustment of the pivot. A positive adjusting device is mounted on the pivot arm extension consisting of two fine-thread thumbscrews and a setscrew. The coarse adjustment is made with the large nuts at the back of the fixture and the final adjustment with the thumbscrews at the front. Below the sine-bar is a similar bar that forms a portion of the base, and by using this bar and the lower face of the sine-bar any angle up to 90 deg. can be accurately determined.

Cutters, "Gray's" Sheet Metal No. 0

W. J. Savage Co., Inc., Knoxville, Tenn.

"American Machinist," July 31, 1919.



Capacity, plate up to ¼ in. in thickness; diameter of drive pulley, 12 in.; face of drive pulley, 2½ in.; speed for general work, 300 r.p.m.; maximum speed, 400 r.p.m.; length of feed per revolution, 3-64 in.; cutting speed per minute at 350 r.p.m., 12 in.; width of belt, 2 in.; depth of thread, 18 in.; width, 12 in.; length over all, 39 in.; height, 24½ in.; horsepower required to operate, ¼ to ½; net weight, 361 lb.

Lubricant Pump, "Rollway"

Michigan Machine Co., Detroit, Mich.

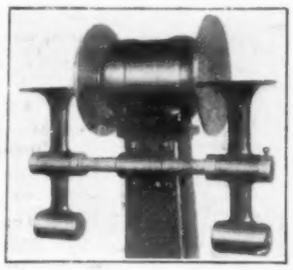
"American Machinist," July 31, 1919.

The principal working parts consist of two rollers which rotate eccentrically in the pump chamber. The tank from which the liquid is being pumped may be entirely emptied and the pump allowed to suck air, after which, if the tank is refilled, the pump will immediately start the flow again. The standard pumps are furnished with a controlling spring to develop a 25-lb. pressure at 200 r.p.m. and a 40-lb. pressure at 420 r.p.m., but springs to develop either higher or lower pressures can be furnished if required. At present the pumps are made in ⅛- and ¾-in. sizes, but sizes ranging from ¼ to 2 in. will shortly be furnished.

Grinding Machine, Electric Double Disk

Forbes & Myers, 172 Union St., Worcester, Mass.

"American Machinjst," July 31, 1919.

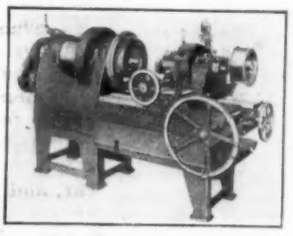


In this grinding machine the disks are 12 in. in diameter and run at a speed of 1800 r.p.m. The tables furnished are of the swinging type, but setscrews are provided so that these can be held stationary if desired. The motor is of 2 hp. and is fully inclosed, the spindle running on Hess-Bright ball bearings protected from dust or grit and packed in grease for lubrication purposes. The motor can be supplied for either two- or three-phase current, 25 or 60 cycle, of any voltage.

Thread-Milling Machine, No. 24

Smalley General Co., Inc., Bay City, Mich.

"American Machinist," July 31, 1919

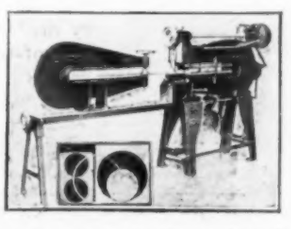


Capacity, work 9-in. outside diameter, 13-in. inside diameter with 2-in. hob; swing over bed, 20 in.; maximum distance from end of main spindle to end of milling spindle, 22 in., longer bed furnished if desired; changes of threads on chucking type, 21, from 3½ per inch up; milling speeds, 3; floor space, 3 ft. 7½ in. by 9 ft. 1 in.; hole through main spindle, 6 in.; standard taper in milling spindle, No. 11 B. & S., No. 13 optional; approximate horsepower required, 4; approximate weight, 2600 lb.

Cutters, "Gray's" Sheet-Metal No. 1

W. J. Savage Co., Inc., Knoxville, Tenn.

"American Machinist," July 31, 1919



This machine has a capacity for stock up to ⅛ in. thick, with the adjustable circle-cutting attachment. This attachment is designed to cut circles, disks, rings, etc., from 8 to 48 in. in diameter, without the necessity of layout or without punching or drilling a hole in the center of the sheet. The device will cut circles of any size from 8 to 48 in. in diameter, but attachments can be furnished for larger diameters on special order if desired. A simpler attachment is also furnished where it is permissible to punch or bore a hole in the center of the plate, this attachment using a pin in which the plate turns while the circle is being cut.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

CINCINNATI	Current	One Year Ago
No. 2 Southern	$30.35	$30.35
Northern Basic	27.55	27.55
Southern Ohio No. 2	28.55	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	32.40	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	35.20	33.95
BIRMINGHAM		
No. 2 Foundry	28.00	26.25
PHILADELPHIA		
Eastern Pennsylvania No. 2	30.65*	30.65
Virginia No. 2	32.10–34.10†	30.85
Basic	30.90*	29.90
Grey Forge	29.90*	29.90
CHICAGO		
No. 2 Foundry local	26.75	26.75
No. 2 Foundry, Southern	28.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	28.15	28.15
Basic	27.15	27.15
Bessemer	29.35	29.35

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	— New York —			— Cleveland —		— Chicago —	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$3.47	$4.245	$3.37	$4.17	$3.47	$4.27
Soft steel bars	3.37	3.37	4.145	3.27	4.07	3.37	4.17
Soft steel bar shapes	3.37	3.37	4.145	3.27	4.17	3.37	4.17
Soft steel bands	4.07	4.07	4.995				
Plates, ¼ to 1 in. thick	3.67	3.67	4.495	3.57	4.42	3.67	4.25

Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows.

	Current	One Year Ago
Mill, N. Y.	$2.77	$3.50
Warehouse, New York	3.37	4.75
Warehouse, Cleveland	3.22	4.10
Warehouse, Chicago	3.37	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	— New York — Current	One Yr. Ago
No. 10	3.55	4.64	4.57	5.80	4.57	5.495
No. 12	3.60	4.69	4.62	5.75	4.62	5.545
No. 14	3.65	4.74	4.67	5.90	4.67	5.595
Black						
*Nos. 18 and 20	4.15	5.24	5.17	6.75	5.30	6.295
*Nos. 22 and 24	4.20	5.29	5.22	6.80	5.35	6.345
*No. 26	4.25	5.34	5.27	6.95	5.40	6.395
*No. 28	4.35	5.44	5.37	7.05	5.50	6.495
Galvanized						
No. 10	4.70	5.79	5.97	....	6.20	6.845
No. 12	4.80	5.89	6.07	7.30	6.25	6.945
No. 14	4.80	5.89	6.07	7.30	6.30	6.945
Nos. 18 and 20	5.20	6.19	6.37	7.60	6.60	7.245
Nos. 22 and 24	5.25	6.34	6.52	7.75	6.30	7.295
*No. 26	5.40	6.04	6.67	7.90	6.45	7.445
*No. 28	5.70	6.79	6.97	8.20	6.75	7.745

* For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List	List plus 12%
Cleveland	5% off	List plus 12%
Chicago	2% off	List plus 13%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	50%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$15.50–19
Cleveland	20.00	20.00
Chicago	16.50	19.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 1/8, 5/32, 3/16, 1/4, 5/16, 3/8 No. 8, 7/16 and No. 10	21.00 to 30.00	3/16 by 12 in. long	14.00
No. 12		1/4 by 19 in. long	12.00
7/16, No. 14 and 1/2		5/16 by 19 in. long	10.00
No. 16		3/8 by 21 in. long	10.00
No. 20		Special Welding Wire, Coated	
Domestic 20c. for 1/16, 15c. for 1/8 to 1/4.		1/8	33.00
		5/32	30.00
		3/16	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.50	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	8.40	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4 and 3/8	50½%	24%	1/8 to 1 1/4	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	1/8 to 1 1/4	39½%	24½%
1/2	51½%	39%			
3/4 to 1 1/4	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	— New York — Black	New York — Galvanized	— Cleveland — Black	Cleveland — Galvanized	— Chicago — Black	Chicago — Galvanized
⅛ to 3 in. steel butt welded	47%	31%	43½%	34½%	57½%	44%
2½ to 6 in. steel lap welded	42%	27%	45½%	30½%	53½%	41%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 12½% less 5% Cast iron, standard sizes, 10–5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	24.00	19.75	26.00
Tin in 5-ton lots	60.00	70.50	94.00
Lead	6.00	5.40	8.05
Spelter	7.625	7.50	8.40
ST. LOUIS			
Lead	5.50	5.00	7.75
Spelter	7.40	6.20	8.10

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	— New York — Current	New York — One Month Ago	New York — One Year Ago	—Cleveland— Current	Cleveland — One Year Ago	— Chicago — Current	Chicago — One Year Ago
Copper sheets, base	33.50	27.50	38.00	34.50–36.50	38.00	36.50	33.50
Copper wire (carload lots)	28.25	24.00	35.00	30.50	35.00	26.00	33.00
Brass sheets	27.75	23.00	39.75	33.00	37.00	28.00	31.50
Brass pipe	36.00	34.00	46.00	39.00	42.00	37.00	41.50
Solder (half and half) (case lots)	45.00	45.00	60.00	41.00	62.00	38.50	70.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$26.75	$32.25
New York	24.25	34.25
Cleveland	30.00	35.00
Chicago	27.00	29.50

Shop Materials and Supplies

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f. o. b. mill 11.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	12.50	18.75	13.00	18.40
New York	11.50	16.50	12.50	17.00
Chicago	16.50	22.00	16.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	9.50	13.25
Chicago	10.25	13.50
Cleveland	12.00	16.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy and crucible	19.00	24.00	18.00	24.00	17.50
Copper, heavy and wire	18.00	22.50	17.00	23.50	17.00
Copper, light and bottoms	15.50	20.50	16.00	21.00	16.25
Lead, heavy	5.00	7.00	5.00	7.00	4.75
Lead, tea	3.75	5.25	3.50	7.50	3.50
Brass, heavy	12.50	14.75	13.50	16.50	16.50
Brass, light	8.50	11.00	10.00	12.50	10.50
No. 1 yellow brass turnings	10.00	13.50	11.00	14.00	11.00
Zinc	4.50	6.00	5.00	6.50	5.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb.	35c.–37c.	32.00c.	33½c.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	33.00	42.00
Chicago	31.00	38.00
Cleveland	35.50	36.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	125.00	80.00	108.00	72.00	100.00
Commercial	50.00	70.00	18.50	23.00	18.00	24.00

SHOP SUPPLIES

New York prices will be revised in next week's issue.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	$1.50	+$2.50	$2.25	$1.20	$2.00	$1.05
Hot pressed hexagon	1.50	+2.50	2.25	1.00	2.00	.85
Cold punched hexagon	1.50	+2.50	2.25	.75	1.30	1.00
Cold punched square	1.50	+2.50	2.25	.75	1.30	1.00

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	50-10%	40%
Chicago	50%	50%
Cleveland	60-10-10%	60%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
¾ by 4 in. and smaller	50%	50%	50–10%
Larger and longer up to 1¼ in. by 30 in.	40%	40%	40–10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York..... $1.25 Cleveland..... $3.75 Chicago..... $2.25

For cast-iron washers the base price per 100 lb. is as follows:

New York..... $6.00 Cleveland..... $3.75 Chicago..... $4.00

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
¾ by 6 in. and smaller	45–5%	40–5%	50%
Larger and longer up to 1 in. by 30 in.	35%	37½%	50–5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	List plus 10%	10%	List plus 10%
Chicago	20%	List price	20%	List plus 20%
New York	40%	20% from list	20%	List plus 20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	50–10%	60%	45%
Tinned	50–10%	60%	40%

Boiler, ½, ⅝, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York...$5.25 Cleveland...$4.00 Chicago....$4.87 Pittsburgh...$4.65

Structural, same sizes:

New York...$5.35 Cleveland...$4.10 Chicago...$4.97 Pittsburgh...$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	37.50	39.50	38.50
Brass	36.00	39.00	37.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., the advance is 5c. over base (100-lb. lots); for less than 50 lb., but not less than 25 lb., 10c. should be added to the base price; and for quantities of from 10 to 25 lb. the extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet-metal mouldings if ordered in above quantities. The above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼ up to 2 in. inclusive in rounds, and ½ up to 1½ in., inclusive in square and hexagon—all varying by thirty-seconds up to 1 in. and by sixteenths over 1 in. On all shipments aggregating less than 100 lb. there is usually a boxing charge of $1.50.

LONG TERNE PLATE—For No. 28 primes, from Stock, the price in Chicago is 7.50 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	13.00	11.00–13.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	11.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½ x 13½	13½ x 20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.75	2.75	2.40
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.65	$3.65	$4.30
Cleveland	3.62	3.62	4.60
Chicago	4.12½	4.125	4.00

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past five weeks:

	Aug. 7	July 31	July 24	July 17	July 10
Prompt furnace	$3.90	$3.85	$4.00	$4.00	$4.25
Prompt foundry	5.00	5.00	5.00	5.00	5.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	per ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$2.25	$1.86	$2.15	$2.10	$2.48	$2.05
5-gal. cans	2.40	1.96	2.40	2.25	2.68	2.25

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	13.00	14.50	14.00	15.50	13.00	14.00
25 and 50-lb. kegs	13.25	14.75	14.25	15.75	13.25	14.25
12½-lb. keg	13.50	15.00	14.50	16.00	13.50	14.50
5-lb. cans	15.00	16.50	.....	.....	15.00	16.00
1-lb. cans	16.00	17.50	.....	.....	16.00	17.00

500 lb. lots less 10% discount; 2000 lb. lots less 10-2½% discount.

Metal Working

NEW ENGLAND STATES

Conn., Forestville—The Peck & Young Manufacturing Co., Stratford Ave., manufacturer of springs, has awarded the contract for 1 story, 60 x 200 ft. factory, a 1 story, 40 x 80 ft. garage and a 1 story, 25 x 35 ft. boiler house. Estimated cost, $50,000.

Conn., Hartford—The Royal Typewriter Co., Inc., 150 New Park Ave., plans to build an addition to its factory. Estimated cost, $175,000.

Conn., Norwalk—The New England Auto Accessories Corp., 50 Main St., has awarded the contract for a 2 story, 80 x 150 ft. factory to be erected on West Ave. and Berkeley St.

Conn., South Norwalk—The Nash Engineering Co., Wilson Rd., will build a 3 story addition to its plant. Estimated cost, $30,000. Noted July 31.

R. I., Providence—M. Hickey, 246 Thurbers Ave., has awarded the contract for a 1 story, 50 x 200 ft. garage and service station, to be erected on Thurston Ave. and Eddy St. Estimated cost, $30,000. Noted July 3.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Baltimore Gas Appliance and Manufacturing Co., Bayard and Hamburg St., has awarded the contract for a 1 story, 25 x 133 ft. addition to its factory. Estimated cost, $10,000. H. W. Hunter, pres.

Md., Baltimore—The Fenway Apartment Co., St. Paul and 34th St., has awarded the contract for a 2 story, 54 x 108 ft. garage. Estimated cost, $55,000. Noted Aug. 14.

N. J., Jersey City—The Buick Motor Co. has awarded the contract for a 4 story, 78 x 148 ft. factory to be erected on Bergen Ave. Estimated cost, $75,000.

N. J., Newark—The O. Heineman Phonograph Co., Wilson Ave., has awarded the contract for the erection of a 80 x 120 ft. factory. Estimated cost, $140,000.

N. J., Newark—The J. E. Lehman Co., Lyndhurst, has awarded the contract for the erection of a 112 x 160 ft. factory and machine shop here. Estimated cost, $68,000.

N. J., Newark—The New Toy Co., 143 Bleecker St., has awarded the contract for a 2 story, 60 x 100 ft. factory to be erected at 219 Central Ave. Estimated cost, $108,000.

N. J., Trenton—C. W. Carll's Sons, 3 West Front St., manufacturer of metals, has awarded the contract for a 1 story, 50 x 175 ft. factory, to be erected on Stuyvesant Ave. Estimated cost, $10,000.

N. Y., Dunkirk—The American Locomotive Works, North Jay St., Schenectady, plans to build a 1 story, 70 x 244 ft. carpenter shop, here. Estimated cost, $70,000.

N. Y., Herkimer—Smith Bros., West Albany St., have awarded the contract for a 1 story, 150 x 200 ft. garage and machine shop. Estimated cost, $10,000. Noted May 15.

N. Y., New York (Borough of Bronx)—The Benesen Realty Co., 148th St. and Willis Ave., will build a 1 story, 60 x 100 ft. garage on 136th St. near Cypress Ave. Estimated cost, $15,000.

N. Y., New York (Borough of Bronx)—Kahn & Shaffer, 18 Stanhope St., Brooklyn, will build a 1 story, 50 x 150 ft. garage on Webster Ave., here. Estimated cost, $10,000.

N. Y., New York (Borough of Brooklyn)—L. Gold, 44 Court St., will build a 2 story, 120 x 180 ft. garage on Atlantic Ave. near Franklin Ave. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—Magid Katzman & Strober, 58 Boerum St., will build a 1 story, 100 x 185 ft. garage and warehouse on Jefferson St., Wykoff and Flushing Ave. Estimated cost, $120,000.

N. Y., New York (Borough of Brooklyn)—J. B. Silman, 1511 Emmons Ave., plans to build a 2 story, 75 x 100 ft. garage on Pearl St. Thompson & Mellema, 640 Broadway, New York City, Arch.

N. Y., New York (Borough of Brooklyn)—J. Sklan, 133 Floyd St., will build a 1 story, 100 x 150 ft. garage on Vernon and Throop St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—J. Allegra, 198 1st Ave., will build a 1 and 2 story, 50 x 100 ft. garage at 519 West 36th St. Estimated cost, $10,000.

N. Y., New York (Borough of Manhattan)—J. A. Chandler, 60 Wall St., will build a 1 story, 50 x 50 ft. garage at 506 West 56th St. Estimated cost, $15,000.

N. Y., New York (Borough of Manhattan)—J. S. Hannon, 445 West 16th St., has awarded the contract for a 2 story, 72 x 95 ft. garage to be erected at 433-437 West 16th St. Estimated cost, $50,000. Noted July 17.

N. Y., Seneca Falls—The Westcott Valve Co., Erie, Pa., plans to build a plant here. Estimated cost, $25,000.

N. Y., Syracuse—The Chapin-Baker Co., 143 Edison St., manufacturer of automobile parts, plans to build a 1 story, 42 x 70 ft. addition to its factory. Estimated cost, $10,000.

N. Y., Syracuse—The H. H. Franklin Automobile Co., 302 South Geddes St., plans to build a 60 x 140 ft. factory on South Geddes St. Estimated cost, $250,000. S. Firestone, Granite Bldg., Rochester, Arch.

N. Y., Syracuse—J. A. Heffernan, 721 South Salina St., will build a 2 and 3 story, 56 x 99 ft. garage on East Genesee St. Estimated cost, $50,000.

N. Y., Syracuse—D. S. Hessler, 214 East Colvin St., manufacturer of hardware, stoves, etc., has awarded the contract for a 1 story, 25 x 58 ft. factory, to be erected at 913 North State St. Estimated cost, $9000.

N. Y. Syracuse—The Syracuse Overland Co., 245 West Water St., has awarded the contract for a 3 story, 100 x 100 ft. garage to be erected at 405-9 Grake St. Estimated cost, $45,000.

Penn., Philadelphia—The Wirt Co., Lena and Armat St., manufacturer of electrical specialties, is building a factory on Queen Lane between Germantown Ave. and Green St., and will probably install new lining and moulding machinery, to take care of its increasing output. Estimated cost, $50,000.

Penn., Wilkes Barre—D. S. Williams, 81 South Pennsylvania Ave., will build a 2 story, 152 x 154 ft. garage, on Northampton St. Estimated cost, $60,000. G. F. Schroeder, 14 Weitzenkorn Bldg., Arch.

SOUTHERN STATES

Ala., Birmingham—The Cruse-Crawford Manufacturing Co. is having plans prepared for a 1 and 3 story, 140 x 150 ft. garage and sales station. Estimated cost, $100,000. W. T. Warren, Empire Bldg., Arch.

Ken., Louisville—B. F. Avery & Sons, 7th and Lee St., manufacturer of harvesting machines, has awarded the contract for a 2 story, 100 x 322 ft. factory. Estimated cost, $115,000.

Va., Taxewell—L. A. Tynes & Co. plans to build a 2 story, 60 x 138 ft. garage and automobile repairing shop.

MIDDLE WEST

Ill., Chicago—The All-American Truck Co., 2952 West Chicago St., has awarded the contract for a 1 story, 60 x 830 ft. factory, to be erected on West Grand and 65th Aves. Estimated cost, $200,000. Noted June 19.

Ill., Chicago—The Dallas Brass and Copper Co., 225 North Jefferson St., plans to build a 5 story, 100 x 135 ft. factory on Orleans St. and Institute Pl. Estimated cost, $200,000. W. G. Uffendell, 39 South State St., Arch.

Ill., Chicago—E. Edelman & Co., 351 East Ohio St., manufacturer of automobile accessories, is having plans prepared by A. S. Alschuler, Arch., 28 East Jackson St., for modern factory, to be erected on Crawford and Shubert Ave. Estimated cost, $250,000.

Ill., Chicago—The Triangle Motors Co., Inc., 2211 South Michigan Ave., has awarded the contract for a 3 story, 60 x125 ft. factory, to be erected at 2229-31 South Michigan Ave. Estimated cost, $85,000.

Mich., Detroit—The Liberty Starter Co., West Fort St., has awarded the contract for a 4 story, 62 x 119 ft. factory, to be erected on 15th and West Fort St.

Mich., Detroit—The Mutual Electric and Machine Co., 232 Fort St., plans to build a 1 and 2 story, 75 x 130 ft. machine shop and office, on 4th and Porter St. Mildner & Elsen, 924 Hammond Bldg., Arch.

Mich., Detroit—C. E. Roger, 34 Goldsmith St., manufacturer of condensed milk machinery equipment, is having plans prepared by Varney & Varney, Arch., 307 Palmer Bldg., for a 1 story, 100 x 214 ft. factory to be erected on West Fort St. Estimated cost, $80,000.

Mich., Flint—Childs Estate, c/o D. C. Childs, Detroit St., plans to build a 1 story, 65 x 86 ft. garage. Estimated cost, $12,000. Geo. H. Swift, Flint, Arch.

Mich., Grand Rapids—The Globe Truck and Vise Co., manufacturer of motor truck parts, plans to build a 2 story, 75 x 125 ft. factory. Estimated cost, $50,000. P. Lindhout, Arch.

Mich., Muskegon—The Piston Ring Co., Sanford and Keating St., has awarded the contract for a 4 story, 55 x 133 ft. factory, a 60 x 65 ft. power house and a 1 story 55 x 65 ft. addition to its present plant.

Ohio, Carthage (Cincinati P. O.)—The Lunkenheimer Co., Beekman, Tremont, Knox, Lawnway and Waverly Ave., Cincinnati, has purchased a site of 70 acres here, directly on the Toledo Division of the Baltimore & Ohio Southwestern R.R. and plans